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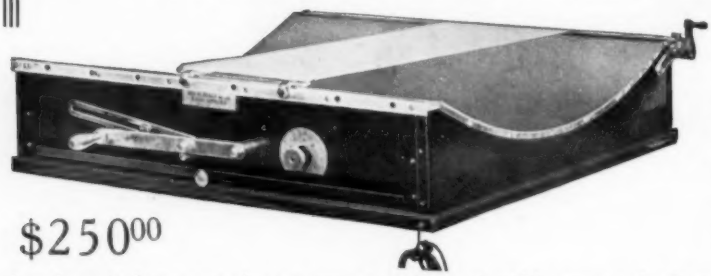

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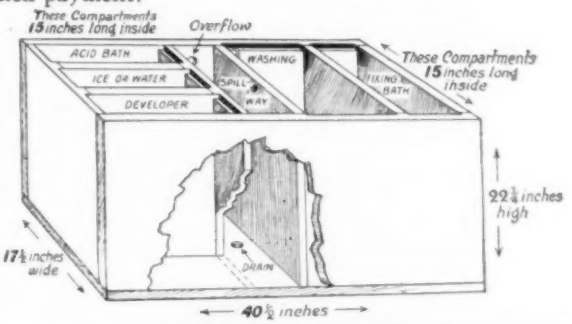

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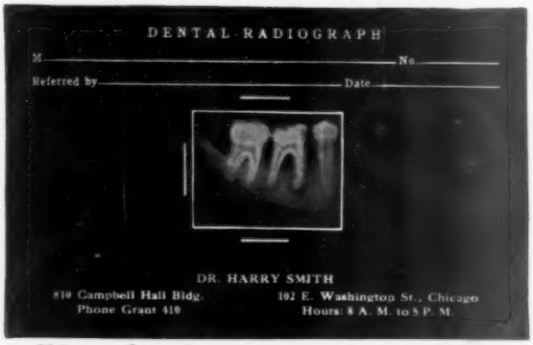

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XV JUNE, 1926 No. 6

THE NEOPLASTIC NATURE OF LYMPHATIC LEUCEMIA AND ITS RELATION TO LYMPHOSARCOMA

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INTRODUCTION

Because of the lack of knowledge of the coordinating etiological factor, lymphatic leucemia formed a favorable subject for wide speculation with regard to its nature and classification. The ordinary type of lymphatic leucemia has, in the majority of cases, a clearly defined clinical picture, and therefore it seems to represent an entity of a uniform etiology; but the many varieties of atypical leucemias, especially because of the wide range of the borderline between these varieties and the typical form, suggest the idea that the different forms of lymphatic leucemia are clinical manifestations of pathological lesions of diverse etiology. Such an interpretation of the subject resulted in the formation of endless theories and a vast literature has grown up dealing with the problem. From the numerous discussions, two conceptions have finally crystallized, which, while antagonistic during the past two decades, seem to arrive now, as a result of more recent discoveries, to some harmonization. These two conceptions are that of an infective nature and that of a neoplastic nature of lymphatic leucemia.

HISTORICAL SURVEY

Chronologically, the first conception advanced was that of the infective nature. Thus the rapid course, and the typically infectious character of some acute forms of lymphatic leucemia stimulated many authors to investigate the bacteriological cause of the disease. Kelsch and Vaillard[1] reported the isolation of a diplobacillus as early as 1890. Pawlowsky[2] isolated another bacillus in 1892. Mosler and Westphal,[3] and Gilbert[4] injected leucemic blood into animals as early as 1889, with the idea of finding the infective cause of the disease. However, all these experiments as well as many others, instituted during the next decade, remained in their end result fruitless, so that Reed,[5] in an article published in 1902, by reviewing the literature up to that time, has to be content with the following general statement: "The leucemia is simply the manifestation of some poison which affects especially the bone marrow, the blood forming organ in the adult, and ultimately causes death."

In 1902, Babes[6] for the first time advanced the theory of the neoplastic nature of lymphatic leucemia. Trans-

formation of certain tumors into lymphatic leucemia was reported much earlier. Thus, Senator[7] in 1882 and Westphal[8] in 1887, described the transformation of pseudoleucemia into lymphatic leucemia. Sadler[9] observed in 1892 the transformation of a round cell sarcoma (probably lymphosarcoma), Palma[10] in 1892 that of a primary sarcoma of the thymus, Martin and Mathewson[11] that of several cases of lymphosarcoma, and finally Ewing[12] in 1899 that of a mixed cell sarcoma (round and spindle cell sarcoma) into lymphatic leucemia. However, these transformations were considered only as accidental occurrences of two distinct lesions. Babes by observing the aggressive and infiltrating character of the chronic lymphatic leucemias, was the first to consider all lymphatic leucemias as true neoplasms. Banti[13] in 1903 made a further step by placing lymphatic leucemias directly in the group of sarcomata. He also claimed that lymphatic leucemia and pseudoleucemia are manifestations of the same disease. Sternberg[14] in 1904 has taken a more conservative standpoint, by making the aggressiveness of the lesion a borderline criterion. Ordinary lymphatic leucemia, especially the acute type, is for him a simple hyperplasia of the lymphoid organs, while the lymphatic leucemias showing tendency to proliferation and infiltration are typical and represent true neoplasms (leucosarcomatosis).

Stimulated by Babes, Banti and Sternberg's writings, a number of publications appeared during the coming years, proving relationship, and in some instances, identity of lymphatic leucemia and various forms of tumors. Warthin,[18] Lehndorff[19] (leucemia sarcomatosa, lymphosarcomatosis leucemia), Moritz,[20] Fellner,[21] Pollak,[22] Mager,[23] Salomon[24] and Pappenheim[25] (lymphosarcomatosis, pseudoleucemia, or sarcoleucemia) described all kinds of tumors belonging mostly to the sarcoma group, which sooner or later transformed into lymphatic leucemia. Fabian[26] reported several cases of thymoma (probably lymphosarcoma) showing the blood picture of typical lymphatic leucemia. While there seemed to be a uniformity of opinion with regard to the neoplastic nature of the lymphatic tumefactions in all these cases, considerable discussion has arisen with regard to the type of cells present in the blood circulation. Sternberg[14,15,16,17] describes them as mononuclear leucocytes. Lehndorff,[19] Pappenheim,[25] Fabian, Naegeli and Schatiloff,[27] and Naegeli,[28] on the other hand consider them as large lymphocytes (macrolymphocytes) occurring in a lesser number in all forms of lymphatic leucemia. Because of the inability to definitely settle the question, Sternberg[17] ingenuously called this type of cells the "bête noir" of the hematologist.

Warthin's[29] discovery in 1907 of the leucemia of the common fowl opened a new field of investigation with regard to the nature of the lymphatic leucemia, that of animal experimentation. Occasional cases of lymphatic leucemia in animals (dogs, swine, cattle) were described much earlier (1858–1889) but it was only the discovery of leucemia in fowl which made animal investigations, especially because of the easy laboratory handling of the fowl, possible. As a result of such investigations, Ellermann and Bang,[30] Ellermann,[32] Hirschfeld and Jacoby[31] and later Schmeisser[34] soon succeeded in transmitting leucemia experimentally from a spontaneous fowl case into several (five to twelve) generations of the same species, thus building up a striking evidence in favor of the infective theory of lymphatic leucemia. Later Ellermann[33] was able to produce both myeloid and lymphatic leucemia within the same generation or in alternative generations by inoculating the same cell-free filtrate, and further by experimenting with a new strain of fowl leucemia he[35,38] succeeded in producing transformations into neoplastic growths, such as lymphomata and myeloid tumors. This latter experiment is very important, since spontaneous transformations of the tumor process into leucemia and *vice versa* was observed much earlier in fowl. Thus Tyzzer and Ordway[36] amongst a series of tumors reported 5 cases of lymphoma with normal blood picture and one case with the picture of lymphatic leucemia . . . Nihonmatsu[37] also described several cases of pseudoleucemia in fowl, some with transformation into lymphatic leucemia.

Numerous experiments were carried out in order to transmit lymphatic leucemia to other animals, especially to mice, but all attempts failed. Only a few years ago did Young[39,40] succeed in producing lymphatic leucemia in mice in a most peculiar way. While he was injecting a microorganism isolated from epithelial tumors of white mice into a number (19) of animals for the purpose of studying the cancer, 84 of his animals died of a leucemic process. The cases which died early showed a typical picture of lymphatic leucemia, while in the cases in which time was allowed for the development of an advanced process the changes were indistinguishable from a sarcoma. From this Young concluded that the virus in question produces a malignant proliferation of the cells of mesodermic origin, but that the same virus, if a local infection of susceptible epithelial cells is accompliished, would result in carcinoma.

Sellards and Baetjer[41] attempted to transmit lymphatic leucemia to monkeys but with no results. However, recently Massaglia[42] described a syndrome observed in a monkey similar to that which characterizes chronic lymphatic leucemia in man.

By carefully studying the results of the above animal experiments, one cannot deny that the evidence in favor of an infective conception of lymphatic leucemia is formidable. This evidence has impressed many investigators who have studied the problem from the clinical standpoint, with the result that the literature of the past decade strongly favors the infective theory, also in human leucemia. Ferrata,[43] von Hansemann,[44] Wilbur,[45] Herz,[46] Holler,[47] Catsaras[48] are the names of only a few investigators in the long list of most distinguished authors supporting this view.

While accepting the conclusive evidence of the above experimentations on animals, a respectable number of investigators, however, strongly maintained that because of the peculiar and very ready response of fowl and mice to infective agents these conclusions cannot be applied to humans. Based on anatomical, pathological and clinical study of leucemia, these authors support the point of view of Babes and Banti, namely that lymphatic leucemia is a true neoplastic process. Thus Lenaz[49] and Piney[50] consider all forms of leucemia as neoplastic, the distinction being only in the type of cells. Leucemias with immature cells, like other tumors, are more rapid in their clinical course; while leucemias with cells of the more differentiated type are of long duration, and thus less malignant. Mallory[51] places all lymphocytic proliferative processes in the same group, and calls them lymphoblastomata. Webster[52] takes a similar view by considering lymphosarcoma, lymphatic leucemia and leucosarcoma as manifestations of the same disease. He thinks, however, that the disease is a direct response on the part of lymphocytes to chemotatic influence exerted by disease-causing agent. Ewing,[53] who in our opinion represents the most advanced view, separates the acute from the chronic form of lymphatic leucemia and while he classifies the acute form as infectious, considers the chronic form as essentially neoplastic, but states that this does not exclude the dependence upon irritants; in fact, the clinical course of the disease rather strongly suggests the continued presence of an irritant of toxic or bacterial nature as the existing cause of the process.

ROENTGENOLOGICAL STUDY OF THE PROBLEM

In view of the many arguments advanced in defense of both the infective and neoplastic conception of lymphatic leucemia and its related processes, we have endeavored to ascertain whether or not the use of radiation, especially the response of the local manifestations of the disease towards a given amount of rays and the changes produced therefrom in the clinical course and pathological feature of the process, would not enable us to draw certain conclusions with regard to the nature and position of lymphatic leucemia and its relationship to lymphosarcoma.

In another place[54] we have already exposed the part the response of a local manifestation of the disease towards radiation, expressed in terms of radiosensitivity, plays in the differentiation of these proc-

esses. We have shown there that the tumor manifestations of lymphatic leucemia, pseudoleucemia and lymphosarcoma show the same degree of radiosensitivity, the tumors disappearing at an equal rate following roentgen-ray exposure, while true Hodgkin's disease, for example, which by many authors is claimed as belonging to the group of lymphoblastomata, shows an entirely different degree of radiosensitivity. The similar behavior of lymphatic leucemia, pseudoleucemia and lymphosarcoma is, in our minds, due to the relationship of these processes, the lymphocyte, typical or atypical, dominating in each instance the morphologic picture, while the different response of Hodgkin's disease is due to the entirely different morphological structure of that process, the disease being a distinct entity. In this paper we should like to carry the problem a step farther by showing that the relationship of lymphatic leucemia, pseudoleucemia and lymphosarcoma, established by the identical radiosensitivity of their structures, is supported also by the possible clinical and pathological transformation of one process into another, if the duration of the disease is sufficiently prolonged, for example by radiotherapy, so as to enable this transformation. Our attention was called to this fact about a year ago, when one of our cases of lymphosarcoma, after radiotherapy had considerably prolonged life, transformed into lymphatic leucemia. Since that time we have reviewed all our cases of lymphosarcoma treated by radiation therapy and found that out of the 16 cases of lymphosarcoma treated during the past four years by deep roentgen-ray therapy, two more cases have developed into terminal leucemia, this making a total of three. The fact that the rest of our patients have remained up to now entirely free of new manifestations of the disease, while the three patients who died all developed in the terminal stage the picture of lymphatic leucemia, strongly suggests the idea that lymphosarcoma and its related tumors under certain conditions—we shall see later which conditions—always transform into lymphatic leucemia. Such a presentation of the subject favors, of course, the neoplastic conception of lymphatic leucemia.

In studying the response of the different types of tumors towards radiation, however, one often encounters phenomena which can only be explained by admitting some kind of infective agent in the origin of these processes. Thus we[55] observed in a case of carcinoma of the breast with generalized metastasis the clearing up of all the metastases following radiation therapy of the pelvic bones. The spontaneous disappearance of tumefactions in lymphatic leucemia following deep roentgen-ray exposure of limited regions of the lymph glands or following the application of small stimulating doses to the spleen is another frequently observed occurrence. But merely from the fact that the greatest number of our lymphosarcomata following deep roentgen-ray therapy remained well, although at the time of the treatment there was a very extensive involvement of the lesions, and there is every indication that some of the smaller foci did not receive treatment, the suspicion arises that some immunization process must be present. A more detailed study of this immunization process leads one to the conclusion that although an extrinsic factor (virus) may be the cause of the constant irritation, the specific feature of the process remains within the cells themselves.

The recent discoveries of Gye[56] and Barnard[57] throw more light on the problem. Their experiments have also a direct bearing on Ellermann's and Young's observations with lymphatic leucemia in fowl. According to Gye, the Rous[58] chicken sarcoma, which because of its infective character, was considered for long similar to Ellermann's chicken lymphatic leucemia only as a "peculiar tissue reaction characteristic of fowl" is a true neoplasm. There are, however, two factors concerned in the etiology of this sarcoma: an extrinsic factor, a virus which Gye succeeded in cultivating and Barnard was able to demonstrate microscopically, and an intrinsic factor, the specific factor, which is presumably produced by the cells themselves in the course of continued irritation. The virus is non-specific, while the specific

factor is strictly specific for tissue and cell. By combining this specific factor of the Rous chicken sarcoma with the virus of Jensen's rat sarcoma or that of the mouse carcinoma, Gye was able experimentally to produce the Rous chicken sarcoma. These experiments are in their results similar to those of Young, who produced lymphatic leucemia in fowl by injecting cell-free extract of mouse carcinoma. Moreover, Gye succeeded in producing Rous chicken sarcoma with the virus from a human cancer, proving thus that the tumors have a virus as their extrinsic cause, but that at the same time specific changes within the cells themselves are necessary in order to insure the progressiveness of the process. This is a point which distinguishes true neoplasm from inflammations. While there is no experimental proof as yet, it is possible that an infective agent such as described by Ellermann for the fowl leucemia or by Gye and Barnard for Rous chicken sarcoma is the provoking cause for the human lymphatic leucemia and its related tumors. The immunization phenomena mentioned above seem to support such a view. Morphologically, however, the processes are true neoplasms, and the fact that lymphosarcoma, if life is sufficiently prolonged, transforms into lymphatic leucemia, proves that lymphosarcoma, lymphatic leucemia, and probably pseudoleucemia are closely related, if not representing manifestations of the same disease.

CASES

The following is a brief abstract of the clinical history and pathological findings of the cases observed:

CASE 1. Mr. C. C., aged twenty-three, admitted to Harper Hospital 12–7–24 as emergency patient, with very pronounced cyanosis and difficulty in breathing. At the time examination was made, patient was drowsy, and because of the very pronounced cyanosis oxygen inhalation had to be applied. The physical examination showed the presence of a mediastinal tumor causing marked pressure on the trachea, and secondary edema of the tissues of the neck and of the left face and left eye (Fig. 1). The roentgenological examination revealed a large mediastinal tumor with evidence of some fluid in the right pleural cavity (Fig. 3). There was no evidence of further tumors or enlargement of any of the lymph glands. The blood count was as follows: R.C.B. 5,030,000; W.B.C. 14,100; P. 72 per cent; S.L. 22 per cent; L.L. 4 per cent; Trans.

FIG. 1. Case 1. Secondary edema of the tissues of the neck, left face and left eye, due to pressure from a very large mediastinal tumor. Before treatment.

FIG. 2. Same as Figure 1, ten days after deep roentgen-ray therapy was given over the mediastinal tumor. Edema disappeared.

2 per cent; Hglb. 80 per cent. Diagnosis of lymphosarcoma was made and immediate deep roentgen-ray therapy was given. The mediastinum and the entire lymphatic system were exposed to the radiation. Oxygen inhalation was given while the patient received the treatment, and this was continued until next day, when the patient's condition started to

FIG. 3. Same case as Figure 1. Large mediastinal tumor with marked pressure on the trachea and with evidence of some fluid in the right pleural cavity. Before treatment.

FIG. 4. Same as Figure 3, ten days after deep roentgen-ray therapy was given to mediastinum. The tumor has entirely disappeared, and the fluid in the right pleural cavity has been absorbed. Patient symptomless.

FIG. 5. Same case as in Figure 1. Three months later patient has developed metastases to the scalp; one of the metastatic nodules—as indicated by the sutured incision—was removed for microscopic examination.

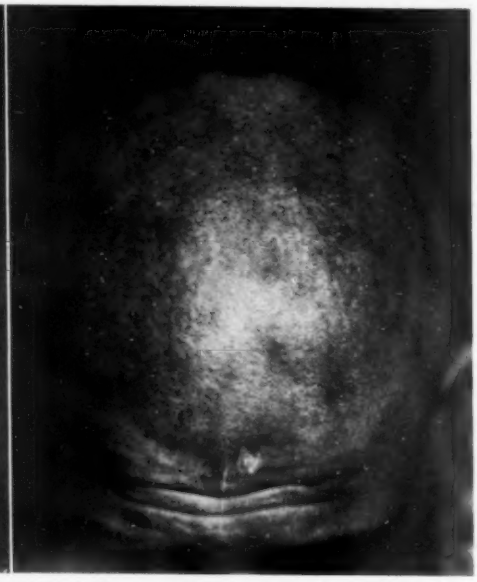

FIG. 6. Same as Figure 5, ten days after deep roentgen-therapy was given to scalp. All metastases have disappeared.

improve rapidly. Within ten days following the treatment the mediastinal mass had entirely (Fig. 2), so that the patient could be discharged from the hospital as practically

FIG. 7. Case II. Large mediastinal tumor with marked pressure of the trachea, and considerable difficulty in breathing. Before treatment.

FIG. 8. Same as Figure 7, ten days after deep roentgen-ray therapy was given over the mediastinum. The tumor has entirely disappeared. Patient symptomless

FIG. 9. Case III. Generalized lymphosarcoma of the lymph glands, more prominent on the glands of the neck. Before treatment.

FIG. 10. Same as Figure 9, ten days after deep roentgen-ray therapy was given over all lymph glands. The glandular enlargements disappeared, and patient's condition improved rapidly.

disappeared (Fig. 4) and also the edema of the neck, face and eye had entirely cleared up symptomless. In March, 1925, however, the patient developed metastatic nodules to the

scalp (Fig. 5). One of these nodules was removed for microscopic examination and this showed lymphosarcoma (Dr. P. F. Morse). Radiation therapy was given over the scalp, and within a few days following the treatment all metastases disappeared (Fig. 6). The end of April, 1925, the patient again returned to the hospital, at this time complaining of very marked pain in both legs. Roentgen examination of the long bones was negative for evidence of bone involvement. Patient showed several skin nodules with small hemorrhagic effusions.

The following is an extract of the post mortem examination made by Dr. P. F. Morse, chief pathologist of Harper Hospital: "Body is that of a young man. Distributed over the skin are numerous bluish red nodular infiltrations varying in size from a small pea to about 2.5 cm. in diameter. The skin is otherwise rather pale. On section we find a diffuse hemorrhage in the muscle of the anterior thoracic wall reaching from the manubrium to the xiphoid. Opening the abdomen, numerous petechial hemorrhages and purpuric spots

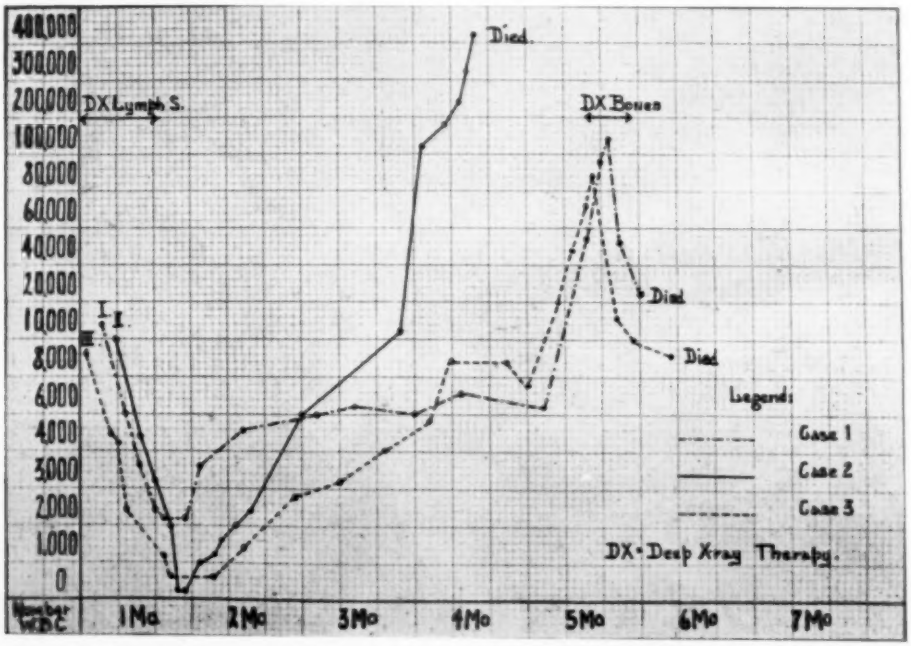

Table 1. The curves register the number of the total white blood cells in the 3 cases of lymphosarcoma described from the time of their first examination up to the time of exitus. The initial decrease in the number of the white blood cells following deep roentgen-ray therapy is due to the radiation effect. About four to six weeks following the roentgen-ray exposure the blood picture returns to normal and usually remains so. In these cases the picture of lymphatic leucemia developed as soon as the lymphosarcoma extended to the bone marrow. In Cases I and III there was a rapid decrease in the number of white blood cells, following deep roentgen-ray (DX) exposure to the long bones.

The blood count at this time showed a very marked anemia; however, with normal white cell count. A few days later patient went over into lymphatic leucemia, which was rapidly progressive (Table 1). May 17, 1925, a skin nodule was removed for microscopic examination and this showed lymphosarcoma (Dr. P. F. Morse). When the number of white blood cells reached 144,000, deep roentgen therapy was given over the long bones. Immediately there was a decrease in the number of white blood cells (Table 1). At this time the patient developed a terminal pneumonia and died May 31, 1925.

are found throughout the peritoneum. Removing the sternum in the usual manner the pericardium is found distended with an increased quantity of bloody fluid. There is no fluid in either pleural cavity. The left lung appears normal. The lower lobes of the right lung are completely consolidated by terminal pneumonic process. Removing the heart, we find it to be of normal size, rather dark brown in color. The epicardium is scattered over by petechial hemorrhages and in the ear of the right auricle is a reddish brown infiltrating neoplastic mass. There are no lesions in the valves or endocardium; no tumor in the

mediastinum; hilus glands very small. Removing the abdomen we find the spleen to be about two and a half times the normal size. On section it shows a diffuse pulp hyperplasia and is uniform in texture. The liver is of normal size, moderately fatty. There is no lesion of the gastrointestinal tract, pancreas or adrenal glands. The kidneys are of normal size and on section present no abnormal appearance. There are no lymphoid areas. The pelvic organs are normal. The marrow of the long bones and sternum shows diffuse hyperplasia of marrow, slightly blotchy and lymphoid in character, but not resembling marrow of typical leucemia."

Microscopically the mass found in the area of the right auricle was a lymphosarcoma. The spleen showed marked hyperplasia and there was a pneumonic process in the lower lungs. The microscopic changes observed in the bone marrow are described further below.

Summary: The case is a lymphosarcoma of the mediastinum with considerable pressure symptoms, which following deep roentgen-ray therapy entirely cleared up. Three months later metastases developed to the scalp. This also disappeared following irradiation. Almost two months later the patient developed skin manifestations and extension of the lymphosarcoma to the bone marrow. At this time the picture of lymphatic leucemia with marked progressive secondary anemia became manifest. The post-mortem examination revealed the only manifestation of the lymphosarcoma in the few skin nodules, and the one nodule discovered in the left auricle of the heart, but there were marked changes, as we shall see, microscopically in the bone marrow. These bone marrow changes were the predominating feature of the disease.

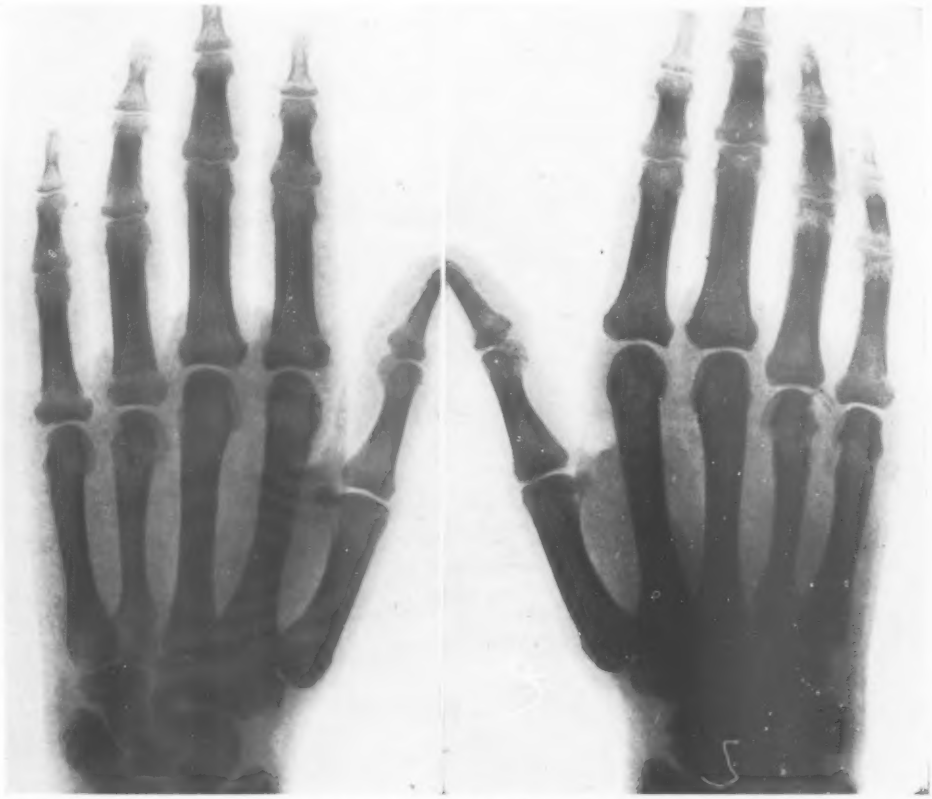

FIG. 11. Bone involvement in a case of lymphosarcoma (Case III). There is marked bone destruction of the shafts of the metacarpals and phalanges of the hands. There is a spontaneous fracture of the distal end of the fourth metacarpal of the left hand.

CASE II. Mr. L. C., aged fifteen. Patient was admitted to Harper Hospital, Sept. 9, 1924, with marked cyanosis and difficulty in breathing. The physical and roentgenological examinations revealed a mediastinal tumor identical with the one described in Case I (Fig. 7). The cyanosis was due to the pressure of the tumor on the trachea and it was so pronounced that

the patient had to receive oxygen inhalation. There was no other tumor mass or glandular enlargement evident at the time of the examination. Blood count was as follows: Hglb. 85 per cent; R.B.C. 4,140,000; W.B.C. 12,500, Diff: P. 64 per cent; S.L. 30 per cent; L.L. 2 per cent; and Trans. 2 per cent; Eo. 2 per cent. The patient was immediately given deep

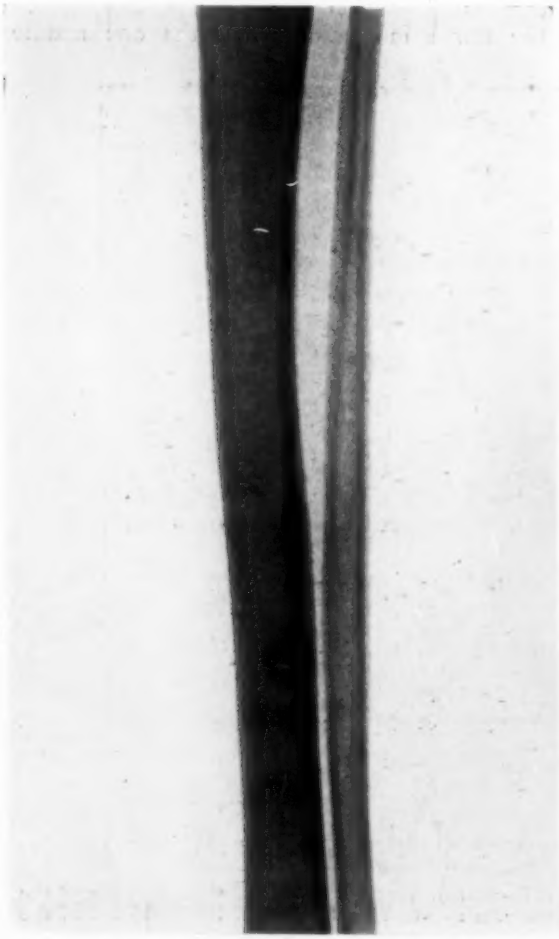

FIG. 12. Same case as Figure 11. There are small localized areas of bone destruction in the shafts of the tibia and fibula.

roentgen therapy over the mediastinum and over the entire lymphatic system. His condition rapidly improved and ten days later the tumor had entirely disappeared (Fig. 8). He returned to school and felt well until the beginning of December, 1924. At this time he complained of general weakness and of considerable pain in both legs. The examination revealed a tumor mass in the left testicle the size of a large orange. No other tumor manifestation was present. The blood count, however, showed considerable increase in the number of the white elements. The process had transformed into a lymphatic leucemia, rapidly progressing (Table 1). The patient suddenly died Dec. 19, 1924, probably from a hemorrhage. No post-mortem examination could be obtained.

Summary: The case is that of a mediastinal tumor with considerable pressure symptoms. Following deep roentgen-ray therapy the tumor disappeared, and there were no other tumor manifestations until three months later when a tumor appeared in the left testicle. At the same time the patient complained of marked pains in the lower extremities, and the picture of a lymphatic leucemia developed. The similarity in the clinical course of the process in this case and the one previously mentioned makes diagnosis of lymphosarcoma apparent. This could not be confirmed pathologically.

FIG. 13. Skin manifestations in lymphosarcoma, after the picture of lymphatic leucemia has developed. There are few tumor nodules interchanged with numerous petechial hemorrhages and subcutaneous suffusions scattered over practically the entire body (Case III).

CASE III. Mr. C. C., aged twenty-one. Patient admitted to Harper Hospital Jan. 1, 1925, with generalized adenopathy. The glands were from 5 to 10 cm. in diameter. All glands were enlarged, the enlargement being, however, more pronounced in the glands of the neck (Fig. 9). One gland was removed for

microscopic examination. This was reported lymphosarcoma (Dr. P. F. Morse). Blood count was normal: R.B.C. 5,440,000; W.B.C. 8,600; P. 78 per cent; S.L. 14 per cent; L.L. 8 per cent; Hglb. 75 per cent. Deep roentgen-ray therapy of the entire lymphatic system was given and there was a rapid disappearance of the glandular enlargement (Fig. 10). In February, 1925, there was some enlargement of the inguinal glands on the left side. Treatment was repeated. Following the second period of exposure the glands entirely disappeared. In May, 1925, the patient developed very intensive pain along both the upper and lower extremities, and the roentgen examination revealed a destructive process of the

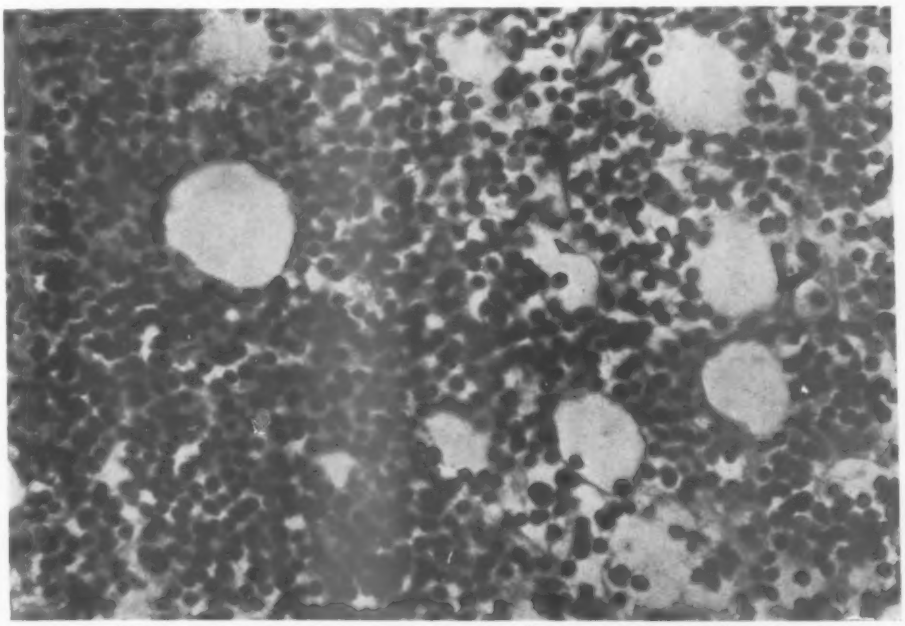

FIG. 14. Fairly normal bone marrow. There is only slight lymphocytic infiltration present.

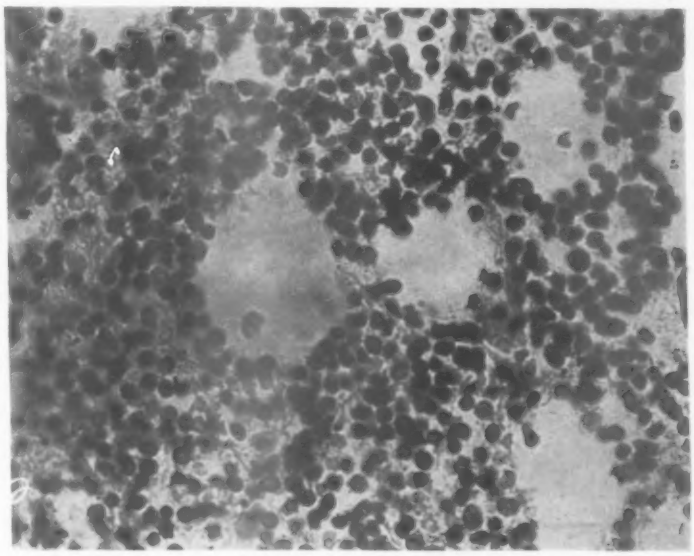

FIG. 15. Lymphosarcoma replaces the normal bone marrow. The cells are microscopically the same as the cells in Figure 16.

phalanges and metacarpals of the hands (Fig. 11). There were also areas of bone destruction in the tibia and fibula (Fig. 12). About two weeks later the patient started to develop numerous skin nodules in places with subcutaneous hemorrhages (Fig. 13), and at this time there was a rapid increase in the abstract of the findings of the post mortem examination (Dr. C. W. Halliday, assistant pathologist, Harper Hospital):

"Body is that of an emaciated young male. There are many spots of purplish color scattered all over the body, varying in size up to 1 cm. diameter. One of these is removed for

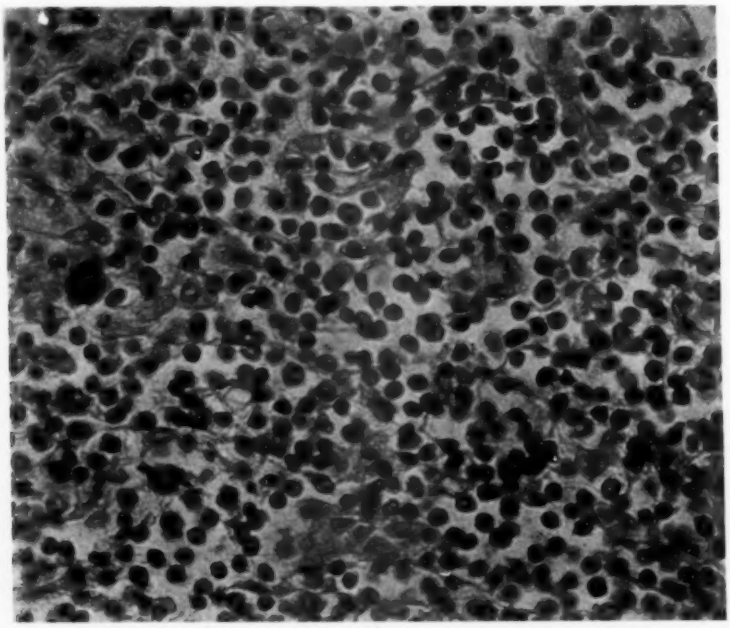

FIG. 16. Lymphosarcoma nodule of the left auricle of Case 1. The identical microscopic appearance of these cells and those of Figure 15, proves the identity of the two processes.

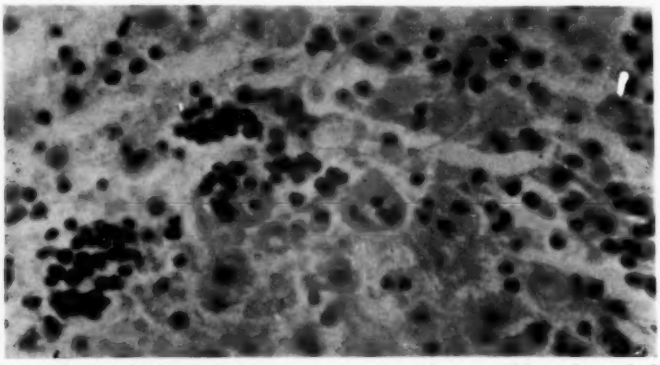

FIG. 17. Marked hyperplasia of the bone marrow around areas of lymphocytic infiltration.

number of the lymphocytes (Table 1). There was also a very severe anemia. When the cells reached the number of 84,000, deep roentgen therapy was given over the long bones and following this there was a rapid decrease in the number of the lymphocytes (Table 1). The patient's condition, however, was deteriorating and he died June 7, 1925. The following is an diagnosis. Incision from suprasternal notch to symphysis. The pericardial cavity contains the usual amount of fluid. The heart is of normal size and there is no evidence of infiltration by any leucemic process. Either chest contains a small amount of fluid. The lungs are markedly congested, and the right lobe (lower) has the usual terminal pneumonia. No evidence of

lymphocytic infiltration. The mediastinum is not invaded by any tumor mass. Six or eight nodes up to one inch in diameter are palpated in this area. Two of these are removed for section. Abdomen: Liver of normal size, very pale, but does not present any other special pathological change. Gall-bladder and pancreas normal. Gastrointestinal tract normal. Spleen of rather small size. No adhesions. No fibrosis. Several nodes are present in the retroperitoneal space. One of these removed for diagnosis. Kidneys are large, capsule strips with difficulty, cut surface shows typical parenchymatous nephritis. Testicle and genitourinary tract are otherwise negative. Piece of bone four inches long is removed from the right tibia; also a piece two inches square is taken from the sternum for inspection of the bone marrow. Pathological diagnosis: Lymphosarcoma. Pneumonia."

Microscopically the skin nodules and the retroperitoneal glands showed lymphosarcoma. There was no tumor involvement of the other organs. There was a terminal pneumonia and parenchymatous nephritis. The very pronounced changes of the bone marrow will be described farther on.

Summary: The case is that of a generalized lymphosarcoma of the lymphatic system, with the most pronounced enlargement of the glands of the neck. Following deep roentgen-ray therapy (2 series) the tumors disappeared. Later there was evidence of skin manifestations and of involvement of the bone marrow. At this time the picture of a lymphatic leucemia with a very severe secondary anemia developed. The post mortem examination revealed but a few nodules in the retroperitoneal glands, and of the skin, showing microscopically lymphosarcoma. The predominating changes were in the bone marrow.

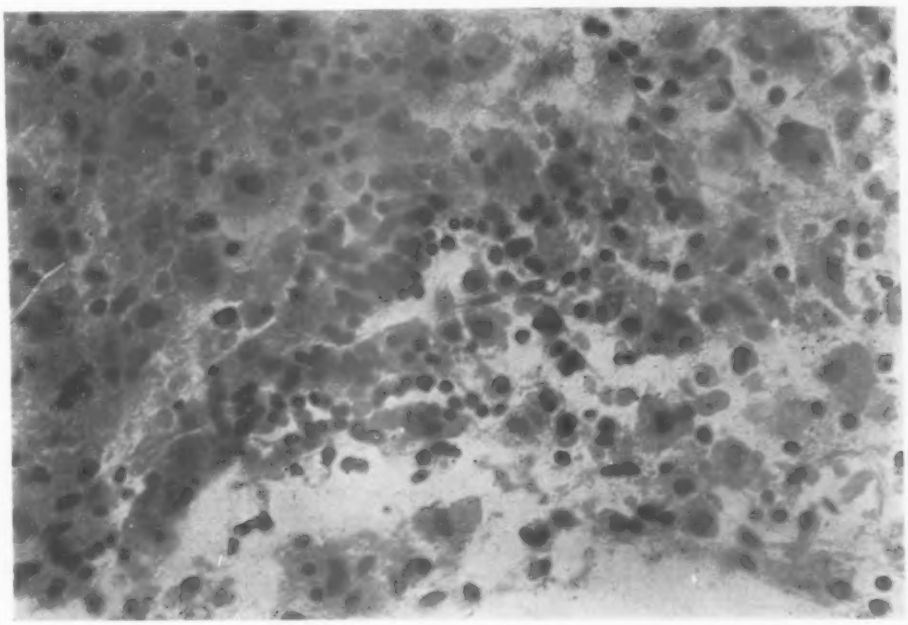

FIG. 18. Same as Figure 17. Large parts of bone marrow being destroyed by the invading lymphosarcoma. The remaining bone marrow shows a hyperfunction, resulting in hyperplasia of the bone marrow cells. When the compensatory hyperfunction becomes exhausted, severe anemia develops.

DISCUSSION

In analyzing the three cases presented, there is one fact which immediately strikes the observer, namely, the uniformity in the clinical course of all cases. Diagnosis of lymphosarcoma of the mediastinum was made in two cases, and lymphosarcomatosis localized to the lymphatic system in one case, with normal blood picture in each case at the beginning. Following radiation therapy the apparent manifestations of the disease immediately disappeared. There was initial decrease in the number of the total white blood cells, as shown in Table 1, due to the radiation effect, but about four to six weeks later the blood picture returned to normal and

the patients resumed their occupations. About three to six months later extensions to the bone marrow, and in two cases also to the subcutaneous tissues, developed. At this time the picture of lymphatic leucemia became manifest (Table 1). This uniformity in the clinical extension of the process indicates that the picture of lymphatic leucemia is not merely a coincidence but is the result of a new localization of the lymphosarcoma. Without radiation therapy, the patients would have died due to the local pressure effect of the rapidly growing tumors, and the picture of lymphatic leucemia would never have developed. Furthermore, in view of the fact that these three patients are the only cases of lymphosarcoma of our entire group who died, and since they all developed the terminal picture of lymphatic leucemia, the suspicion arises that all lymphosarcoma, if life is sufficiently prolonged, would terminate as lymphatic leucemia. In studying the cause of the appearance of the lymphocytes in the blood circulation, we have from the beginning turned our attention to the bone marrow. In all our cases there was an intensive pain along the long bones several weeks or months before the pictures of lymphatic leucemia developed; this suggesting that the process probably has its new location in the bone marrow. Repeated roentgen-ray examinations of the long bones were made in order to determine any destructive changes, but the results were negative. Only in Case III have we been able to show in the almost terminal stage of the disease evidence of bone destruction. This was most pronounced in the shafts of the metacarpals and phalanges of the hands (in one of the metacarpals spontaneous fracture occurred) (Fig. 11) and in localized areas of the shafts of the tibia and fibula (Fig. 12). In two of our cases leucemic skin manifestations with marked petechial hemorrhages and subcutaneous suffusions developed just before exitus (Fig. 13). However, that such skin lesions cannot be responsible for the increase in the number of the circulating lymphocytes, is evidenced by the fact that in both cases the picture of lymphatic leucemia developed before the appearance of the skin manifestations. In the third case there were no skin manifestations at all. This leaves us only one alternative, that the organ responsible for the transmission of the lymphocytes into the circulation is the bone marrow.

The theory that the bone marrow is the seat of the primary lesion in lymphatic leucemia is not a new one. Neuman,[59] Müller,[60] Pappenheim[61] and Brandenberg[62] from autopsy findings considered bone marrow in every form of leucemia as the seat of the disease. Reed,[5] in 1902, said with regard to this: "In the so-called lymphatic leucemia there is almost unanimity of opinion that the blood is not leucemic until the bone marrow is involved." Later Kelly,[63] Gulland and Goodall,[64] Schultze[65] and recently Piney[50] express the same opinion, but the conclusions of these authors are based purely on gross pathological and histological findings. In our cases, evidence is brought—quasi in an experimental way—that lymphocytes appear in increased number in the blood circulation as soon as the bone marrow becomes involved. Moreover, in two of our patients we have exposed the long bones to a destructive dose of roentgen rays, and the number of lymphocytes in the blood dropped as soon as the proliferative activity of the bone marrow metastases was destroyed (Table 1). (The same phenomenon is observed in treating chronic lymphatic leucemia by exposing the long bones to radiation.)

The changes observed in the bones consist of marked invasion of the bone marrow by the lymphosarcoma nodules. In places there is conglomeration of miliary metastases, in other places again the nodules fuse to greater tumor islands. The cortex remains intact, except for occasional areas of invasion by the process. Sometimes miliary leucemia nodules are found under the periosteum and especially near the epiphyseal end. The respect of the invading lymphosarcoma for the cortex of the bone is remarkable, and this explains well the negative roentgenological findings in almost all of our cases. Histologically, the process is characterized by replacement of the bone marrow by the invading tumor mass (Figs. 14 and 15), and secondarily by the gradual

destruction of the normal bone marrow tissue. The microscopic appearance of an invading nodule is that of a typical lymphocytic proliferation. As shown in Figures 15 and 16, the type of cells of the processes involving the marrow is the same as that of a metastatic nodule from the left auricle of the heart, found in Case 1. The differentiation of the lymphosarcoma from the textbook picture of chronic lymphatic leucemia, purely upon microscopic examination of the invading nodules, is impossible. Because of the gradual destruction of the normal bone marrow by the extending lymphosarcoma a hyperfunction with marked hyperplasia of the remaining bone marrow will develop (Figs. 17 and 18). When the destructive action of the tumor exceeds the compensatory hyperfunction of the remaining marrow, fatal anemia develops. In some instances, because of the low vitality of the organism, secondary infection (pneumonia, nephritis, etc.) hastens the end.

Because of the above changes produced in the bone marrow, two kinds of cells will enter the circulation: the discharged tumor cells, the type of "bête noir" cells of Sternberg, which are atypical lymphocytes and therefore may show all variations of neoplastic transformation, and the cells resulting from functive irritation of the bone marrow. The number of lymphocytes may be so considerable that they entirely dominate the picture (anywhere from 40 to 99 per cent) while the myelocytes or myeloblasts as a rule appear in a very small amount (1–7 per cent).

CONCLUSIONS

The 3 cases described prove without doubt that lymphosarcoma transformed into lymphatic leucemia as soon as the bone marrow became involved by foci of lymphosarcoma. The blood started to show an increased number of lymphocytes as soon as the symptoms of the bone involvement became manifest, and the lymphocytosis was in direct relation to the extent of the bone marrow involvement. Irradiation of the long bones produced an immediate drop in the number of the circulating lymphocytes.

Since lymphosarcoma transforms into lymphatic leucemia as soon as the bone marrow becomes involved, the question arises as to whether or not chronic lymphatic leucemia is a primary lymphosarcoma or a related process of the bone marrow. Of course, the acute lymphatic leucemia, or the secondary lymphatic leucemias, as observed after certain infections, form an entirely distinct group and are not considered here. But the chronic lymphatic leucemia, with the typical blood picture, shows a striking similarity to our observations above, inasmuch as it does not show any lymphocytes in the blood until the bone marrow is involved, and then its severity increases in direct relation to the bone marrow involvement. We have exposed the long bones in several such cases of primary lymphatic leucemia to radiation, and the decrease in the number of the lymphocytes occurred at the same rate, as in the two cases described above. The observations made by Webster and several others, that lymphatic leucemia occasionally transforms into generalized lymphosarcoma also favors the theory of the close relation of the two processes.

We acknowledge that—except for the identical radiosensitivity—we have no definite evidence in proving that the typical chronic lymphatic leucemia is a primary lymphosarcoma or a related process of the bone marrow. We think, however, to have brought the problem one step nearer its solution by proving that lymphosarcoma is transformed into lymphatic leucemia as soon as the bone marrow becomes involved. The picture from this moment on remains indistinguishable from the typical chronic lymphatic leucemia.

SUMMARY

Three cases of lymphosarcoma are described which in their terminal stages changed into lymphatic leucemia. These 3 cases are the only lymphosarcomata in a group of 16 patients treated by deep roentgen-ray therapy during the last four years, which had a fatal termination. In all 3 cases radiation therapy produced prolongation of life with entire disappearance of the manifest lesions treated, but later

extension to the bone marrow occurred. At the time of the bone marrow involvement, all three patients had developed the picture of lymphatic leucemia. Evidence is thus brought that lymphosarcoma, if life is sufficiently prolonged, may change into lymphatic leucemia. This happens as soon as the bone marrow involvement becomes the predominating feature of the disease.

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STUDY OF SKIN REACTIONS AFTER DIVIDED ROENTGEN-RAY DOSAGE

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THE amount of roentgen rays that can be given to a deep-seated tumor is often limited by the amount the skin will tolerate. It has therefore been one of the outstanding problems in roentgen-ray therapy to find the skin erythema dose expressed in quality and quantity of roentgen rays. There has been much discrepancy concerning this dose due to the poor definition of it and due to unsatisfactory physical measurements of the absorbed roentgen-ray energy. It was often claimed that the skin reaction varied greatly with the individual and that idiosyncrasy to roentgen rays was common. Lately it has, however, been fairly well established that the fluctuation in reaction is usually less than 20 per cent and that idiosyncrasy to roentgen rays is rare. The skin reaction is, however, dependent upon how the radiation is given and upon other influences, such as pressure during treatment, which will tend to reduce the reaction, and pressure, friction and other kinds of irritation after treatment which will tend to increase the reaction. It was recognized early that less skin reaction was produced if a certain dose was divided over several days than if the same dose was given in one sitting. This showed that the roentgen-ray effect accumulates in the tissue and made it necessary to study the relation between the length of time in which the radiation was given and the effect produced.

The phenomena of accumulation can, from a physical point of view, be divided into three problems.

1. Most roentgen-ray machines used for treatment produce an intermittent radiation, some for instance giving 50 impulses per second, others 120, and so on, while a few of the machines now in use give rise to continuous radiation. Is the same effect produced in the tissue by these different kinds of radiations, provided that the quality and total quantity of the radiations are the same? In other words, is the effect of impulses with intervals of $\frac{1}{50}$ second the same as the effect of impulses with intervals of $\frac{1}{120}$ second and the same as the effect of a continuous radiation? Experiments made by Holthusen gave the result that the difference in effect was less than the experimental errors (about 10 per cent).

2. A certain dose applied without interruption can be given either in a relatively short time with great intensity or in a relatively long time with small intensity. What is the difference in the effect produced? It has been established that the reaction of the skin is more marked the shorter the time and the greater the intensity. A difference has been noticed (exceeding the experimental errors of about 10 per cent) when the relation between the intensities is 4:1. The greater this relation, the greater the difference in effect.

3. A certain dose given in one sitting will produce a more pronounced skin reaction than the same dose given in portions with an interval of a day between. Even if the interval is as short as an hour a difference in reaction can be noticed. The experiments we will report here refer to time intervals of several days.

During the last few years there has been a tendency among radiologists to divide the dose given on a certain field in portions distributed over one to two weeks. In this way the time during which the patient in one sitting has had to stay in an uncomfortable position on the treatment table has been reduced, the roentgen sickness has been almost eliminated and the total dose for each field could be increased. It is, however, not enough to know that a greater dose can be given, it is important to know exactly how much more the skin can stand under these conditions.

Certain assumptions have been made concerning the law governing the accumulation. Kingery[1] assumed that the disappearance of the effect follows the law of mass reactions which is graphically illustrated by an exponential curve. That means if $\frac{1}{2}$ of the effect is left after n days, $\frac{1}{4}$ will be left after $2n$ days, $\frac{1}{8}$ after $3n$ days, etc. This assumption seems reasonable and is evidently the best one we can make until we have enough experimental data. Kingery worked with "soft" radiation and came to the conclusion that $\frac{1}{2}$ of the radiation effect disappeared in $3\frac{1}{2}$ days. Consequently, it should be possible to give 100 per cent of an erythema the first day and then add 50 per cent the 4th day, 50 per cent the 8th day and so on without damaging the skin. We will not consider "soft" radiation here, but only mention that it would not be possible to keep on with many treatments in this way if the first dose really was a full erythema dose. With "hard" radiation it is well known that a 50 per cent addition the fourth day to 100 per cent of an erythema dose the first day would bring about a severe reaction. It is also well known that a 100 per cent dose cannot be repeated without danger within a month, and we do not even consider it safe to repeat the dose until after two months. When it comes to more accurate determinations there are several things to consider: the constancy of roentgen-ray energy, the difference in reaction between individuals, the difference in the reaction of the skin on different parts of the body, the difference in irritation of the irradiated areas and the fluctuation in reaction with time. The last question has been investigated by Miescher[2] who found that three to four waves of reaction follow each other with a time interval of sixteen to thirty days between the peaks. A reliable estimate of the reaction can therefore be obtained only if the field is watched at short intervals for several weeks. The question also arises, "What will happen if the first wave from one portion of the dose coincides with the second wave from an earlier portion or the second wave with the third, etc.?" Will the reaction be equal to the sum of the two or will it be larger

or smaller? Evidently the exponential curve cannot be relied upon for such estimations. We have not as yet experimentally studied the last problem but have tried to avoid such complications by giving the whole treatment before the second wave sets in. It is possible that the first wave has coincided partly with the second in two of our cases. The first wave after the treatment which starts almost immediately is, however, usually weak in comparison with the second and third, and is considered to be different in character.

We have tried to avoid the above mentioned sources of error by comparing the reactions on two adjacent fields on the same patient. One of the fields was given 100 per cent of our standard erythema dose in one sitting. The other field was given a somewhat larger dose divided into definite portions so that about one-half of the dose was given before the other field was irradiated and one-half after the other field had been irradiated. We tried to keep the conditions as nearly the same as possible during the different sittings. The same roentgen-ray machine, the same voltage, milliamperage, size of field, distance and protection were used. The reactions on the two fields were compared during the following weeks. It is evident that the dose could be divided in a great number of different ways. We divided it in equal parts with about equal intervals between. It was, of course, difficult to find suitable patients for such experiments. A large area of skin similar in structure was required. Furthermore, the patients had to be observed for a long time. As we could not keep them in the hospital during this time they had to come to the Institute at intervals. Only patients living in the vicinity who could be expected to cooperate could be considered. We have therefore, carried out these experiments with only 6 patients. The results can, however, be considered reliable because they were congruous and because adjacent fields were compared. One of the patients was used for a preliminary experiment to find out about how much smaller the reaction was when the 100 per cent dose was divided. All the data obtained from the other 5 patients are compiled in the accompanying tables.

We will call attention to the fact that these radiations constituted the treatments of the patients. As the region treated could be divided with advantage into two fields and as it was not known whether a single dose or a divided dose would prove most beneficial, there could be no objections to the experiments. We had in mind to establish a practical basis for treatments with divided dosage and therefore chose time intervals which seemed practical, and fields of moderate size. We did not feel justified in giving such large doses to healthy individuals for experimental purposes.

All the patients were females treated for cancer of the breast. The first one in the table received the treatment on the left side; all the others on the right side. All the fields were of the size 10 × 15 cm. The upper field on each patient was given a single dose of 100 per cent and the lower field was given a divided dose. The radiations were given under the following conditions: 200 kv., 8 ma., 50 cm. target skin distance, 0.5 mm. copper filter, 0.5 cm. wood filter and 0.16 A effective wave length.

TABLE I

Patient	Age	Divided Each Time, Per Cent	Dose Total, Per Cent	Days of Div. Dose				Day of 100 Per Cent
C. L. n.	56	30	120	1	3	8	10	6
M. B. n.	41	35	140	1	6	8	12	7
M. G. r.	68	35	140	1	4	8	11	5
A. C. r.	37	37.5	150	1	4	10	15	8
M. K. r.	56	35	140	1	4	7	11	5

TABLE II

REACTIONS

Patient	Day	100 Per Cent	Div.	Day	100 Per Cent	Div.	Day	100 Per Cent	Div.	Day	100 Per Cent	Div.	Day	100 Per Cent	Div.
C. L.	15	1	½	19	7	½	26	7	½	36	4	½	50	T	0
M.B.	12	1	1 –	14	2	1	24	2	1	26	4	2			
M.G.	14	2	2	21	3	3	28	6	3	39	5	2	67	1	½
A.C.	15	4	4 –	25	2	2 –	36	1	1	50	1	1 –			
M. K.	17	1	1	36	5	2									

"Days of divided dose" in Table 1 means that, for instance, the first patient received 30 per cent the first day and 30 per cent the third, eighth and tenth days,

the whole treatment being completed in ten days. "Day of 100 per cent" means that the second field received 100 per cent that day; n indicates that the patient had not received radiation before, r that the whole skin area used had been irradiated earlier as one large field.

The figures in Table II representing the reactions are arbitrary and may not mean quite the same for different patients or for the same patients at different days. However, they indicate the relative reaction of the two adjacent fields at the same day; ½ means that the reaction was hardly noticeable; 7 is the highest figure used and refers to a rather severe reaction followed by desquamation; 15 under "day" means the 14th day after the 100 per cent had been given. The columns "div." refer to the reactions on the field which had received divided doses and columns "100 per cent" refer to the other field.

Case No. 1 shows that 120 per cent in ten days does not give nearly the same reaction as 100 per cent in one sitting. Cases Nos. 2, 3 and 5 demonstrate that 140 per cent will give nearly but not quite, the same reaction when given in eleven days as 100 per cent given in one sitting. Case No. 4 indicates that 150 per cent given in fifteen days will give very nearly the same reaction as 100 per cent given in one sitting. Certain other things may be studied in the tables, for instance, relations between reactions and age and between reactions and re-irradiation.

We may conclude from these data that four equal doses with about equal time intervals will produce very nearly the same reactions on the skin as 100 per cent of the standard dose given in one dose if they are given in ten days and total 140 per cent and if they are given in fourteen days and total 150 per cent. From mathematical calculations we find that the exponential curve which corresponds to our value of 140 per cent in ten days can be written $I = I_0 \times e^{-.0833t}$ where I_0 is proportional to the dose given in one sitting and I proportional to the part of this dose which is effective after t days; e is a constant = 2.718. One-half of the effect should, according to this equation, wear off in 8.33 days. The curve is shown in Figure 1. Such a curve is of value for an approximate estimate of how much can be added to a certain dose after a certain interval. For instance, if 100 per cent is given in the morning of the first day, 50 per cent could be added in the afternoon of the ninth day or 44 per cent on the eighth day, etc.

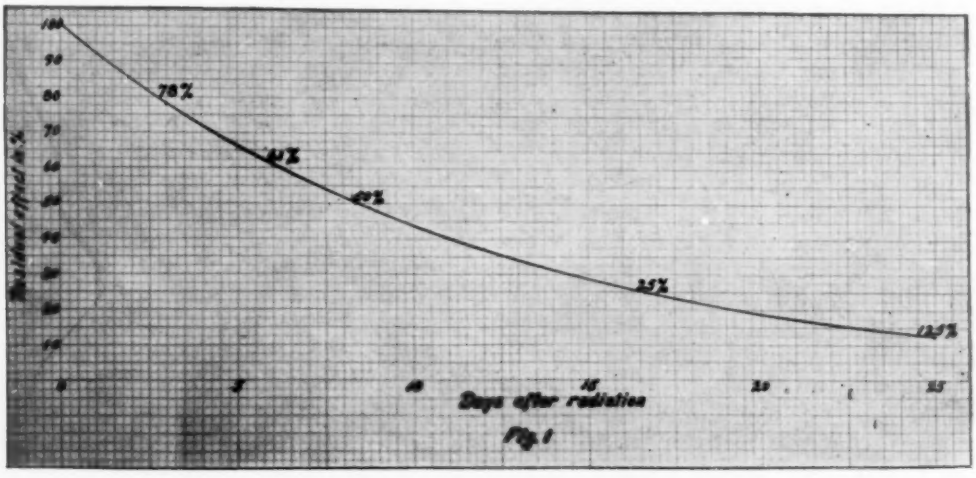

FIG. 1.

Figure 2 shows how the effect of the radiation is built up and disappears when 140 per cent is given in four equal doses with equal time intervals in ten days. By means of the above equation, the dosage required for any distribution can be calcu-

lated. For instance, with the treatment divided into four equal doses with equal intervals, 113 per cent could be given in four days, 126 per cent in seven days and 154 per cent in thirteen days. These values fall nearly on a straight line as shown in Figure 3, and we can use this line to estimate the erythema dose for treatments divided in the way just mentioned over any length of time from one day to fifteen days. We have repeatedly treated patients with 120 per cent in five days, 130 per cent in eight days, 140 per cent in ten days and 150 per cent in fourteen days. The reactions after these irradiations have been, as nearly as we could judge, the same as after a single 100 per cent dose.

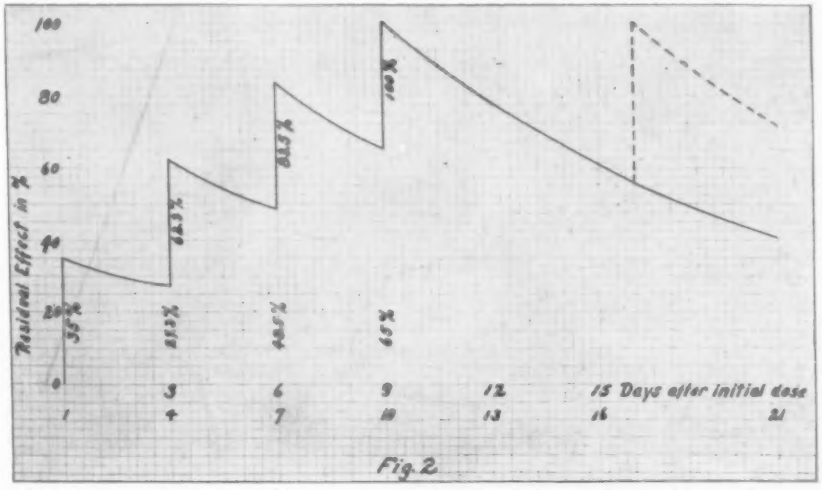

FIG. 2. Accumulation of roentgen-ray effect when 35 per cent of the erythema dose is given every fourth day until 140 per cent has been reached the fourth time on the tenth day.

It is evident that the curve given in Figure 1 can also be used to estimate the doses required to keep the skin "saturated" with radiation for some time after the full erythema dose has been given. The curve indicates that 8 per cent may be given every day, 44 per cent every eighth day (once a week) or 50 per cent every ninth to tenth day. We want to emphasize the fact that these estimations are built upon an assumption which is doubtful and that they refer only to the skin. We have given some patients an additional dose of 20 to 30 per cent a week for two to three weeks after a full erythema dose had been applied. No undesired reaction of the skin has so far resulted from this procedure, except possibly in one case where the skin was indurated and peeled rapidly. The new skin was, however, smooth and the patient did not complain of any discomfort after a month. We have as yet no experience as to what will happen if a second series of treatments is given after an interval of two to three months on a skin which has received this so-called "saturation dose." It is natural that great caution is called for. We know that the erythema dose can be repeated without untoward results if 130 per cent has been divided over eight days, or 140 per cent over ten days.

What we have stated so far refers only to the skin reaction. The effect on tumors and other tissues can be established on humans only with help of the usual statistical method with a great number of patients studied for several years. The general opinion among radiologists seems to be that the divided dose will lead to better results than the full erythema dose given in one sitting. However, the problem is complicated. Holthusen[3] has recently discussed the problem of accumulation of radiation in tissue. He calls attention to experiments which seem to prove that the accumulation is complete in cells which are irradiated in a resting state and that the loss of radiation effect is more rapid the faster the tissue is growing. Dry

seeds store the radiation effect completely. Sprouted seeds lose the radiation effect fairly rapidly, but accumulate it completely if they are kept on ice and thus brought to rest. Bacteria can be irradiated for weeks with radiation of small intensity without showing any effect from it, while they will be killed in a short time by intense irradiation. Holthusen refers to several other findings of similar character and makes the assumption that the same rule for the accumulation of the radiation effect will hold for human tissue. He then draws some conclusions concerning treatment of patients. Rapidly growing lymphosarcoma should wear off the radiation effect faster than the skin and should as a consequence be given the required dose at once (if rapid destruction is desirable). Carcinoma remnants left behind after operation, for instance of a breast, are probably in a state of rest. They should, therefore, accumulate the radiation to a greater extent than the skin, the muscle and the connective tissues. Small doses repeated in shorter or longer intervals should therefore, be preferable in this case; even intervals of one to two months may be satisfactory. The skin would then have time to recuperate completely.

We can draw other important conclusions from this theory which may explain some of the results which have seemed mysterious. Cartilage should accumulate the radiation well as it is slow growing. The breaking down of this tissue which has been reported in the literature may be due to repeated irradiation with intervals of months. It is known that the dose required to produce an erythema on the skin of a cachectic patient is large, but that the skin is apt to break down if the dose is repeated, this also fits in with the theory. The single dose required to produce an erythema on an old person is considerably greater than the corresponding dose for a child. We may expect, however, according to this theory that relatively more can be added to the dose for the child than to the dose for the old person if it is divided over a week or fourteen days. Also it should be possible to repeat the treatment of the child sooner than the treatment of the old patient. The findings concerning the skin reaction after divided dosage which we have reported here could, therefore, not be utilized to predict the skin reaction for children and for cachectic patients.

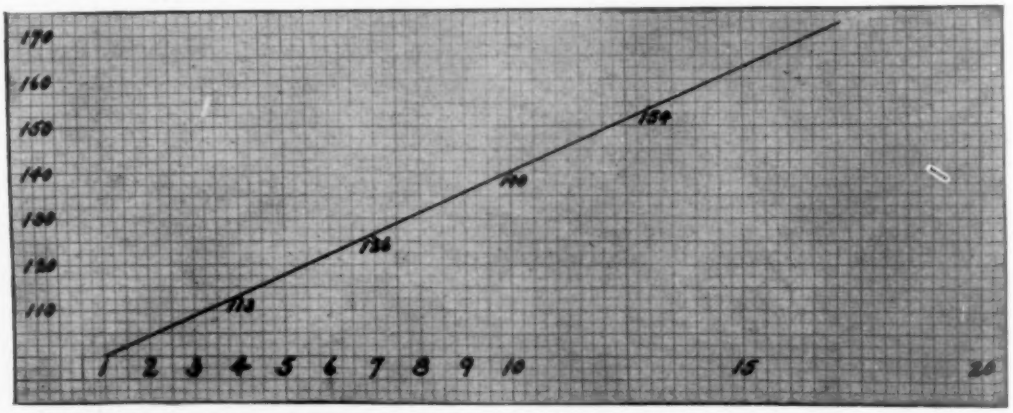

FIG. 3. Relation between the total roentgen-ray dose required to produce a certain skin reaction, and the time over which this dose is distributed in four equal parts with equal time intervals.

As already mentioned, we have determined the roentgen-ray quantities administered in a specified way during five to fourteen days which will produce the same erythema dose as a 100 per cent dose given at once for "normal" patients between the ages of thirty-five and seventy years. When this method of treatment is of advantage and without danger for other kinds of tissues than the skin is difficult to determine. Each patient must be considered individually in this respect by the radiologist. The theory we referred to

shows that it may be dangerous to use this kind of treatment arbitrarily and is given as a warning.

SUMMARY

1. It is important to know the quantitative relations between the skin reaction after roentgen radiation and the time distribution of the radiation. Difficulties and sources of errors for determinations of these relations have been discussed.

2. By comparing the erythema produced on the skin of two adjacent fields on the same patient some relations of this kind have been determined. Six patients were studied in this way. One of the fields received a single 100 per cent dose of "hard" radiation, the other field received a larger dose of the same kind of radiation divided into four equal portions which were given at about equal intervals of time. It was found that 140 per cent given in ten days produced the same reaction as 100 per cent given in one day.

3. If the law of mass reactions is assumed to hold for the effect of roentgen irradiation of the skin, the absorption constant of the exponential equation determining the relation between time and residual effect can be calculated from our experimental value just given. The dose required to produce a skin erythema when divided can then be calculated for any desired distribution of radiation as to time. Some examples are given. It is evident that these calculated values must be considered as estimations as it has not been proven that the law of mass reactions holds here, and great caution must be exercised.

4. A theory concerning the accumulation of radiation in human tissues has recently been discussed by Holthusen. This theory has been further considered here. It points out the dangers which are attached to the divided and repeated irradiations with large doses and emphasizes the necessity of considering each patient individually.

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A NEW METHOD FOR THE STIMULATION OF ENDOCRINE GLANDS WITH RADIUM

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WITH regard to the action of small doses of roentgen rays upon endocrine glands two theories have been advanced. Holzknecht,[13] in Vienna, and his followers, claim that it is possible to increase the activity of the glands of internal secretion by small doses of roentgen rays, but that this result is not obtained by a stimulation of the cells themselves, but by the depression of an inhibitory factor, thus freeing the cells from some restraining influence which he thinks is acting constantly. This theory would presuppose that the inhibiting influences are more susceptible to the action of roentgen rays than the stimulating or activating ones, for the reason that small doses of roentgen rays decrease the former only, while it requires much larger doses to depress the latter. Other observers hold that small doses of roentgen rays actually stimulate or increase the activity of the glands by exerting a direct action upon the cells themselves, and not upon an inhibiting force or substance. The depression or diminution of glandular activity by large doses of radiation is simply taken as representing a fatigue or exhaustion which occurs as the result of a preceding over-stimulation. This latter theory seems to be the more generally accepted.

It is immaterial which of these theories one accepts, since the fact remains that small doses (0.01 to 0.1 of the erythema dose) of roentgen rays increase the amount of glandular secretion poured into the blood stream, while large doses decrease the output.

It has generally been observed that the harder rays, i.e., those with shorter wave lengths, are more likely to exert a stimulative action than are rays of a longer wave length. This was brought out some years ago by Heuneke, Dominici,[5] Theis, and others, and has been confirmed by many recent investigations, among them those of Holzknecht,[13] Recasens,[19] Eiken,[6] Gutzeit, Brinkmann and Kötschau,[9] Colwell and Russ,[3] Chambers and Scott, and many others, until it is now accepted as one of the fundamental principles of irradiation. This phenomenon has not been seen to occur, however, as a constant geometrical progression, but there are certain optimum wave lengths for different glands and in different individuals. For example, Colwell and Russ,[3] in their recent work on "Radium, X rays and the Living Cell," and I. Seth Hirsch,[11] in his textbook on radiology, expound this principle as one of the first laws of radiation. Colwell and Russ say, "The cells of some tissues are more affected by a given dose of radiation than are the cells of other tissues when exposed to the same dose. In some cases, at least, the cells of a tissue are more affected by a given amount of energy of one range of wave lengths than they are by the same amount of energy of another range of wave lengths."

It has been our endeavor to find a rational explanation for these results, both for our own satisfaction and for the purpose of supplying a working basis for our researches. After a great deal of careful study, we propose the following hypothesis.

It has been found by many recent as well as by older observers that the protoplasm of a cell is in a state of constant and continuous vibration, presumably of a definite wave length. Chambers and Russ quote Gardiner as far back as 1895 as being much impressed by the flux of all granules in the otherwise quiescent eggs of the *Polycboerus*. Similar cytoplasmic movements have been observed in the living cells of the pancreas, in certain nerve cells, and in the highly visualized cytoplasm of the aster. Geddes and Thompson[8] speak of the cell as "a minute body of unmeasured chemical complexity, in a watery phase, with many different kinds of particles quivering in suspension." From this conception of the cell the inevitable conclusion is that the protoplasm must be in a constant state of fluctuation, or vibra-

tion, which is essential for its normal functioning.

When roentgen rays are produced the ether is thrown into a state of vibration of a certain wave length. If the rays are directed toward a living cell, the ether waves meet those of the protoplasm of the cell and necessarily influence the latter. If the rate of vibration, set up in the ether by the roentgen rays, harmonizes with that of the cell protoplasm, a resonance will be produced which will increase the intensity of the electronic waves within the protoplasm, and as a result, there will be a correspondingly increased cellular activity. If, on the other hand, the vibrations of ether and those of the cytoplasm do not harmonize because of improperly mated wave lengths, there is not only no augmentation but an interference with, or depression of, intracellular protoplasmic movements with a consequent diminution in cell output. Again, a too great augmentation of cellular activity results in fatigue and depression as, for example, in cases in which a large dose of rays, having the appropriate rate of vibration is employed.

In order that there may be perfect resonance between the ether vibrations and the cellular protoplasmic wave movements, that is, a resonance analogous to that existing between a tuning fork and a piano wire, or between two tuning forks having the same rate of vibration, or one having an exact multiple of the other, the ether vibrations should be either of the same wave length or wave frequency as those of the cytoplasm, or an exact multiple thereof. As a general rule, the shorter the wave length of the rays, the more frequent will be the occurrence of the exact multiple of the protoplasmic vibrations in a definite period of time (e.g., one second).

Although this holds true in a general way, other factors must be considered which will have a bearing on the effects of rays upon cells. For example, let us suppose that the protoplasmic vibrations have a rate of 10 per second, and the ether vibrations a rate of 14 per second, there will then be an interval of 5 seconds before the exact multiple of 10 and 15 is reached, i.e., 70. If, however, the vibrations number 15 per second, it then requires only 2 seconds to reach the first exact multiple of 10 and 15, namely, 30. While there is very little difference between a rate of 14 and one of 15 vibrations per second, yet it is evident that if the hypothesis is correct, the results will be two and one-half times as good with 15 as with 14 vibrations. The 15 vibrations would then be nearer the optimum wave length, and 20 or 30 the real optimum.

We are not unaware of the various views that have been advanced to explain the action of the rays on living tissues, such as that the rays decompose the lecithin in the tissue cells, and that its disintegration products act in an ingenious manner. This action, as pointed out by Wakeley,[22] has not been substantiated, and likewise, most recent investigations fail to demonstrate any specific activation of intracellular enzymes. The same is true of experiments upon oxidase, lactase and trypsinase. Wakeley believes it not improbable that one of the effects of irradiation is the disturbance of the colloid equilibrium of the cells. The hypothesis which we have advanced would go a step further, in that it would explain why there is a disturbance of colloid equilibrium.

In our experimental and practical work we have been led to employ the gamma rays of radium instead of roentgen rays, inasmuch as with radium, shorter wave lengths can be obtained and standard conditions can be more easily secured and duplicated.

After searching for a suitable method of applying small doses of gamma rays of radium, we had an applicator constructed in which radium was evenly distributed over a fairly large surface—2 by 4 inches. Various types of filters could then be interposed between the radium and the area of the body to be irradiated. Brass, copper, silver, and aluminum filters of various thicknesses were employed, and the radium skin distance was varied from 2 cm. to 15 cm. The amount of radium applied to the 2 by 4 inch surface ranged from 10 mg. to 40 mg. In every case a hard rubber plate was interposed in order to absorb the secondary radiations. The length of time of exposure ranged

from one to fifteen minutes for each gland.

The glands in which results were most easily observed were, in the order mentioned, the adrenals, thyroid, ovaries, pituitary, testicles and parathyroids. In the case of the pineal gland, and the islands of Langerhans, the results were too indefinite to warrant a report at this time.

The adrenal glands were found to be most susceptible to irradiation with either roentgen rays or radium, their susceptibility to the former having been shown by various investigators. For example, Zimmern and Cottenot selected individuals who were suffering from abnormally high blood pressure, and treatment with roentgen rays was pursued with the object of ascertaining whether the action of the rays would effect a reduction of the arterial pressure. In some cases it was found that a single heavy exposure sufficed to produce a well-marked diminution in pressure, but in most cases a series of exposures lasting over several months was necessary to reduce it to any appreciable extent. David and Hirsch,[4] finding that the literature furnished no unanimous view as to the possibility of stimulation of the adrenals by roentgen rays, gave doses of 100, 75, 50 and 25 per cent of the skin erythema dose, using filters of 0.5 mm. of zinc; 3, 2, and 1 mm. of aluminum, and thus showed that the adrenal system is amenable to the influence of roentgen rays. A distinctly weakened function was obtained with irradiations of one erythema dose, while a functional increase was obtained with irradiations with one-fourth of an erythema dose. Holfelder and Peiper[12] have shown that the adrenal gland is twice as sensitive to roentgen radiation as the intestinal epithelium, and they emphasize the danger of over-treatment of these glands.

In our work we determined the results of irradiation, objectively, as well as subjectively; objectively, taking the blood pressure just previous to irradiation, and again five minutes after the removal of the apparatus. The patient was not allowed to move during the entire procedure in order to avoid disturbing the blood pressure readings, which would naturally show an increase on exertion. For the purpose of eliminating the possibility of psychic reactions, the majority of the irradiations were preceded by one in which a lead filter was interposed. In our series of 116 patients, no difference in the blood pressure was noted when the lead filter was used, while on actual exposure, 78 per cent showed a rise in blood pressure of 5 to 28 mm. Hg systolic, and a rise of 8 to 23 mm. Hg diastolic, and 22 per cent of the patients were not affected by irradiation alone. Although the blood pressure in some cases was subsequently raised by other procedures (elimination of toxins, foci of infection, etc.), none of this series showed any appreciable drop of blood pressure. The most decided change was observed in those patients who came with an initial pressure of 97 to 115 mm. Hg systolic, while those with less than 97, or above 115, were less, or not at all affected.

Subjectively, the patients who were benefited by this treatment, reported that they experienced a sense of general warmth, especially in the legs, improved memory, physical endurance, and a feeling of buoyancy and increased endurance, both physical and mental. These results were not permanent, however, unless other glands were also irradiated, or supplementary treatment was also given.

The effect of irradiating the thyroid gland has been studied by a number of investigators. Leo Loeb[15] found that weak intensities of roentgen rays stimulate metabolism, which he checked up by basal metabolism tests, as well as excitability of motor and sensory nerves. A number of other observers who have worked on the thyroid gland confirmed these statements.

In our series of 60 cases with diminished thyroid function, all had a basal metabolic rate of minus 10 or lower. Most of these irradiations were carried out with 30 mg. of radium, 1.5 mm. brass filter, 10 cm. distance and 7 minutes' exposure. This was repeated every second day for 16 treatments. In 62 per cent of these cases the metabolic rate was increased 6 to 18 per cent; 20 per cent were doubtful; and in 17 per cent the results were negative. In one case there was a decrease of 6 per cent in the metabolism rate. The pulse

frequency was increased from 9 to 32 per minute, and in some cases we noticed a slight increase in blood pressure. Subjectively, the skin became smoother in texture in some patients, the bowels became more regular and the circulation in the hands and feet was improved.

The results were much more permanent here than the elevation of blood pressure in the cases where the adrenals were irradiated. It was interesting to note that we could frequently observe an increased metabolism rate immediately after the irradiation, as compared to that before. This increase ranged anywhere from 6 to 14 per cent. Controls with lead filters were made in every case of this series.

The ovaries proved to be much less sensitive to the irradiations than the adrenals and the thyroid. The only objective results we were able to produce were: in some cases of oligomenorrhea, an increase of the flow; and in certain cases of ovarian obesity, a decrease in fat accumulation. In many cases, however, subjective symptoms were manifested, such as increased libido, amelioration of certain nervous symptoms and insomnia, turgescence, and a sense of fullness of the breasts, and greater endurance. A few other observers have recorded encouraging results following the administration of small doses of irradiation with roentgen rays in cases of amenorrhea. Recasens,[19] for instance, cites the case of a young woman who, after four years of relatively regular menstruation, became amenorrheic without evident local, or general disturbance. Functional regularity was established by the application to the ovaries of one-fifth of an erythema dose of roentgen rays. Our series of this group consisted of 48 cases, of which 61 per cent showed positive or, at least, fair results, while 39 per cent were more or less negative.

In regard to the pituitary gland, the nicest results were seen in the amelioration of the symptoms of the menopause, such as hot flushes, nervous symptoms, insomnia, and some cases of so-called "climacteric rheumatism." A reduction in weight was also noted in a few patients. A number of observations are reported in the literature where the irradiation of the pituitary gland with small doses of roentgen rays resulted in accelerated growth in experimental animals. Our own animal experiments, however, are not reported in this paper.

The testicles are much more resistant to radiation than the glands which we have just considered. They require three to five times as large a dose as the ovaries in order to obtain approximately corresponding results. Here, nothing but subjective symptoms, similar to those noted in the case of the ovaries, could be detected. However, in testicular dysfunction, especially, there are other glands which are deficient or over-active, and these should also be treated. In irradiating the testicles, it was found, as other observers have reported in the case of roentgen rays, that if the irradiation was preceded by a thorough heating with diathermy, the results were much more pronounced, and a shorter exposure was required, the increased activity in these cases did not seem to be due to the direct action of the diathermy, but rather to the increased susceptibility of the cells to the radium irradiations; for the cases treated by diathermy alone, and those treated by radium first, and then followed by diathermy, did not show the same effects. Of 46 cases in this series, 19 showed marked improvement, 14 slight improvement, and 13 remained apparently unchanged. Of the latter group, 8 patients subsequently showed improvement after treating the prostate by diathermy, and the sinusoidal current.

The effect of irradiations upon the parathyroid glands was determined by a comparison of the blood calcium content before and after a series of treatments. In the cases where a hypofunction of the parathyroids was suspected, the blood calcium was determined, and if it was found to be less than 7.5 mg. per 100 c.c. of blood, they were irradiated. In nearly every case, an increase in the calcium content was observed, varying from 2 to 5.5 mg. per 100 c.c. In those cases where the thyroid gland was treated for hypofunction, and where the calcium content was below normal, we almost invariably obtained a rise varying from 2 to 4 mg. per 100 c.c. of blood. It was interesting to

note, however, that when the calcium content of the blood was about normal, very little or no elevation in values was observed.

The results obtained after irradiating the islands of Langerhans were not sufficiently definite to warrant the expression of an opinion at this time. This holds true with even more emphasis in the case of the pineal gland. However, further studies along these lines are in progress and we hope to be able to report with more definite assurance in the near future.

It goes without saying, that in the majority of cases more than one gland is deficient or dysfunctioning; for this reason, nearly all of our patients received radiation over several glands. However, the cases herein reported are those in which only one gland was treated, at least for a considerable period of time, in order not to obscure the picture.

The technique consisted simply in inserting into the applicator the amount of radium that seemed to be indicated, selecting the proper filter, and adjusting the apparatus over the particular gland in a manner similar to that employed in the application of roentgen rays. The least amount of radium, the greatest radium-skin distance, and the heaviest filters were used for the adrenals; and the greatest amount of radium, the shortest radium-skin distance, and the least filtration, in the irradiation of the testicles. The time of exposure ranged from one to fifteen minutes per gland, being shortest, as a rule, for the adrenals, and longest for the testicles. This rule, however, does not hold true in every case.

Expressed in erythema dosage, we never exceeded a total of $\frac{1}{20}$ of the skin erythema dose. This was usually divided into 10 to 20 exposures given on alternate days.*

SUMMARY AND CONCLUSIONS

1. Radium distributed evenly over an area of 2 × 4 inches in a specially constructed applicator was used to stimulate endocrine glands.

2. A hypothesis has been formulated to serve as a working basis for our experiments and to attempt to explain our own observations, as well as those of other authors.

3. This hypothesis seems to fit in quite well with many empirically found results.

4. All of the important known glands of internal secretion were treated by radium irradiation and definite results obtained in the case of the adrenals, thyroid, ovaries, pituitary, testicles and parathyroids. In the case of the pineal gland and the islands of Langerhans, the results were too indefinite to warrant a report at this time.

* Thanks are herewith expressed to the Wappler Electric Company, and to the Pittsburgh Radium Chemical Company, for valuable suggestions, and for the construction of an applicator.

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LYMPHOBLASTOMA (HODGKIN'S DISEASE) OF THE STERNUM

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ZIEGLER,[5] in his very complete monograph on "Hodgkin's Disease," states that involvement of bone is a relatively frequent occurrence. This, however, is not in accord with our experience. In a large series of cases studied at the Massachusetts General Hospital, a very small number showed skeletal lesions. This may be due in part to the fact that we have but recently directed particular attention to this manifestation of the disease.

The osseous changes which we have noted have been confined to the sternum, and this paper will be limited to a discussion of lymphomatous involvement of this region.

Pfahler[4] has called attention to the fact that involvement of the sternum in malignant disease is frequently overlooked, and has recommended a technique for the roentgen-ray examination of this region which we have followed, with slight modifications. A case of Hodgkin's disease, which in its course involved both the sternum and spine, is reported by Louste, Thibaut and Valiere-Vialeix.[3] LaRoy[2] in a series of cases of "tuberculosis simulating pseudoleukemia" records a neoplasm of the sternum which probably falls into the lymphoblastoma group.

In a review of 95 cases of lymphoblastoma observed in the department of radiation therapy of the Massachusetts General Hospital during the past three years, 4 presented a tumor mass in the region of the sternum. One of these cases, which was very completely studied, will be reported in some detail; the others will be briefly summarized.

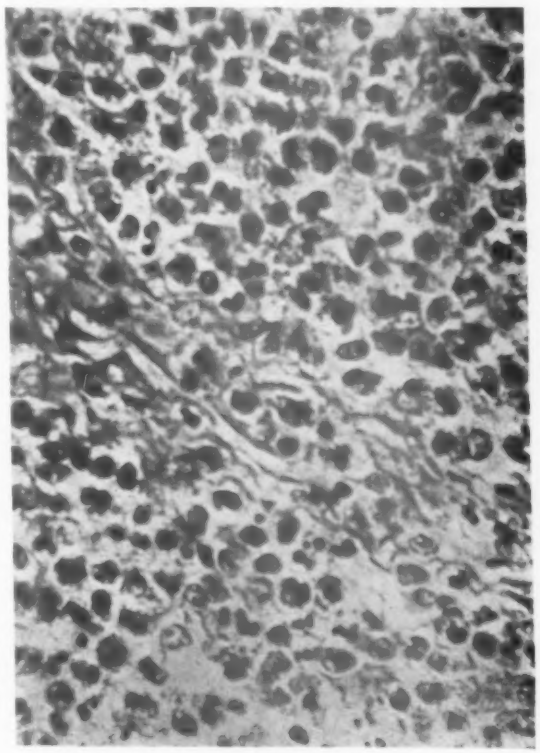
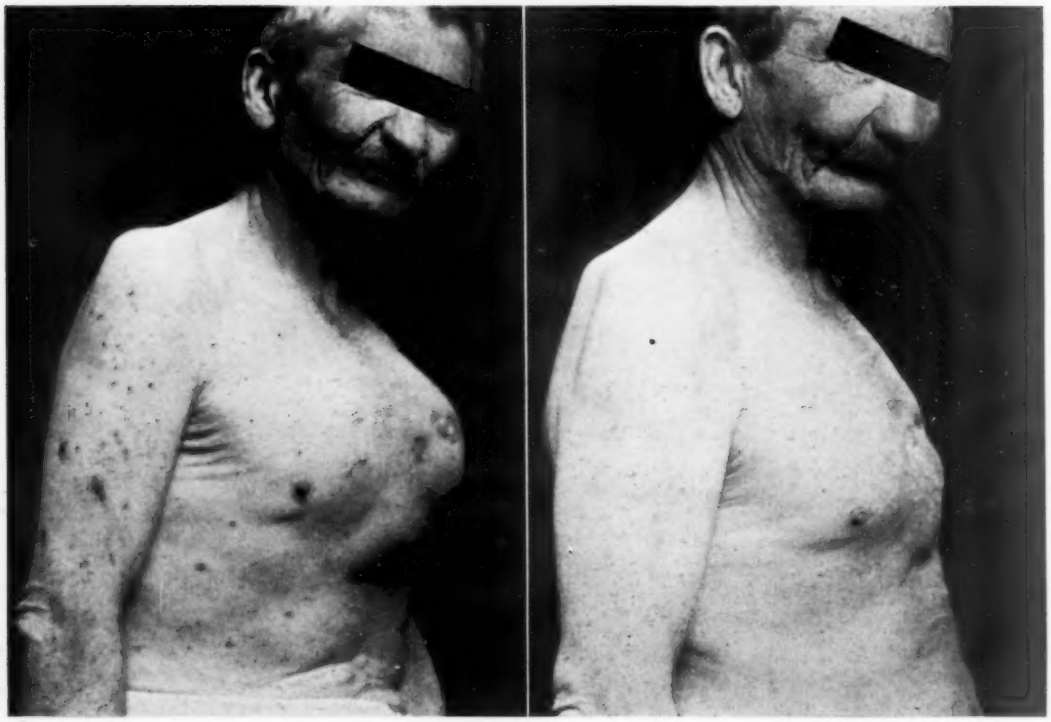


FIG. 1. Section from sternal tumor. Case 1.

CASE REPORTS

CASE 1. P. K. A laborer, aged forty-nine, first came under observation in June, 1923. His chief complaint was generalized itching of the skin. There was nothing of note in the



a *b*

FIG. 2*a* and *b*. Lymphoblastoma of sternum showing marked improvement four weeks after short wave irradiation.

FIG. 3. Soft tissue swelling and destructive process in sternum. Case 1.

family history. The anamnesis disclosed a chancre at the age of twenty.

In 1921, the patient noticed a swelling in the left axilla, accompanied by some pain. Shortly after this, a similar condition developed in the right axilla. A local physician was consulted, and the blood Wassermann was found to be positive. A course of salvarsan was administered, during which treatment the patient developed a marked generalized pruritus which persisted in spite of various local remedies.

Physical examination on admission to the hospital revealed numerous excoriated areas over the trunk and extremities. Marble-sized glands were present in the groins, axillae, and in both sides of the neck. There was a small swelling over the upper part of the sternum which the patient had not noticed himself.

The urine was essentially negative. The blood Wassermann was found to be strongly positive; the spinal fluid Wassermann negative. R.B.C., 5,000,000; W.B.C. ranged from 10,000 to 25,000. The polymorphonuclear neutrophiles were increased to 86 per cent, otherwise the differential count appeared normal. Roentgen examination of the chest showed a slight increase in the width of the mediastinal shadow,

which, however, was not characteristic of glandular enlargement.

A gland was removed from the axilla and examined by Dr. H. F. Hartwell. The report was as follows: A tumor composed of large atypical cells of the lymphocyte series, infiltrated with leucocytes, many having eosin-staining cytoplasm. Areas of fat-holding mononuclear cells occur, and there is considerable fibrosis. Pathological diagnosis: A fibrous type of Hodgkin's disease.

a *b*

FIG. 4*a* and *b*. Complete disappearance of sternal tumor following one series of roentgen radiation.

The patient was referred for roentgen-ray treatment the latter part of June, 1923. A series of high voltage, copper-filtered radiation was given to the superficially enlarged glands, and to the chest. A month later the sternal tumor had entirely disappeared, although glands were still palpable in the axillae.

In March, 1924, the swelling in the anterior chest wall recurred. In view of the luetic history, it was thought that this might be a gumma. A biopsy was performed, and the specimen (Fig. 1) was found to be microscopically identical with the axillary gland removed several months previously; there was no evidence of syphilis.

The tumor was again reduced by irradiation, and the patient was kept in fairly good condition until August, 1924. He was then lost track of until March, 1925, at which time the following note appears on his record: "The patient returns in rather deplorable condition. He complains of constant itching which keeps him awake at night. He is weak, and unable to work. The sternal mass has fully doubled in size since the last observation. The skin in places over it is red and tense, and looks as though it might easily break down. There is a large, horsechestnut-sized gland in the left neck, which also presents a tense, shiny skin surface above. There is a large mass in the left axilla; very little in the right axilla. The skin over the entire body is covered with excoriations from the scratching." At this time the photograph which is shown in Figure 2*a* was taken. A roentgenogram of the sternum (Fig. 3) showed soft tissue swelling, and a destructive process in the bone. The aortic shadow was normal.

Another excerpt from the record, April 22, 1925 is as follows: "The patient has concluded a series of short-wave radiation over the anterior chest, left neck, and axilla. There has been a most surprising reduction in the size of the chest tumor, and the glands in the axilla and neck are smaller. The itching now gives very little discomfort. The excoriated areas over the trunk and extremities have disappeared to a large extent. The only skin reaction is in the left axilla, where there is a slight but definite tanning. This is probably due to overlapping of the areas treated. Photograph taken" (Fig. 2*b*).

At the time of writing, this patient is still alive. It is more than five years since the onset of his symptoms. He is reporting regularly, and is being kept comfortable by frequently repeated irradiation.

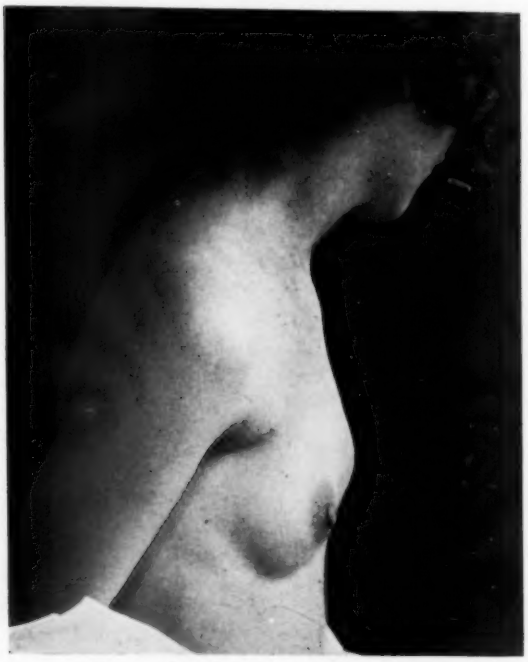


FIG. 5. Small sternal tumor. Case III.

CASE II. O. L., aged thirty-five. A well-built, muscular farmer entered the hospital with the complaint of shortness of breath, and swelling of the face and neck (Fig. 4*a*). Enlarged glands were palpated above the clavicles, and in both axillae. A firm, elastic, painless tumor, the size of a man's fist was present over the upper sternum. Clinically, there was evidence of mediastinal pressure. Roentgen examination of the chest revealed a large mediastinal mass characteristic of lymphoblastoma. A satisfactory roentgenogram of the sternum was not obtained. The pathological report on a gland removed from the neck was lymphoblastoma. The sternal tumor, mediastinal mass, and superficially enlarged glands disappeared completely following one series of short wave radiation (Fig. 4*b*). The patient is still free from symptoms after the lapse of ten months, and it has not been necessary to repeat the treatment during this period.

CASE III. E. K. A girl of nineteen with a two-year history of lymphoblastoma of the superficial lymph glands, proved by pathological examination, developed a small, bone-like, painful swelling of the lower part of the gladiolus (Fig. 5). Roentgen examination of the chest showed no abnormality of the mediastinal shadow. An oblique view of the sternum (Fig. 6) revealed a definite, destructive process within the bone. The sternal tumor, as well as the lymphadenopathy has been well controlled by short-wave radiation, and the patient's general condition is still good, four years after the onset of the disease.

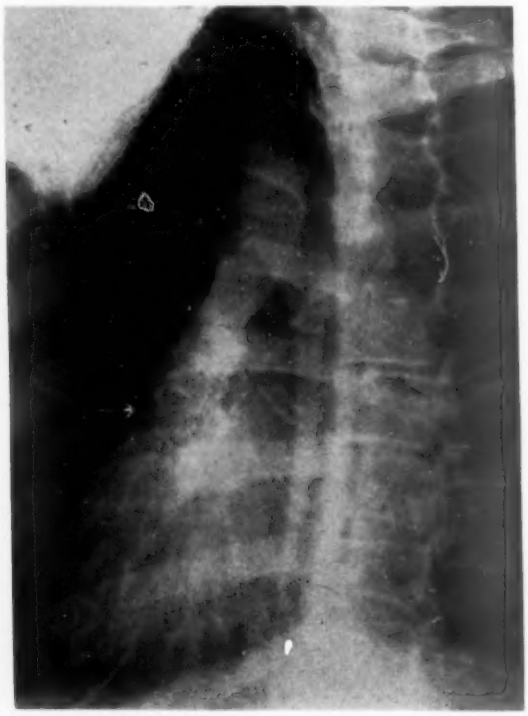


FIG. 6. Oblique view of sternum. Case III. Note the destructive process in lower end of gladiolus.

CASE IV. A. S., aged forty. An Italian laborer presented in the course of a generalized lymphadenopathy, proved by biopsy to be lymphoblastoma, a large, painful swelling of

the sternum which incapacitated him for work. There was no enlargement of the mediastinal glands. This was the first case of this nature which we had observed, and the probability of a lymphomatous neoplasm was not seriously considered. In the light of our present knowledge, we believe that thorough irradiation of the anterior chest wall would have produced an alleviation of symptoms, but unfortunately only a very cautious therapeutic attempt was made, the dosage being too small. The patient became discouraged and went elsewhere for treatment. We later learned that he died fourteen months after the onset of his illness.

There are certain salient features in the cases here reported and in those collected from the literature which may be summarized.

Lymphoblastoma of the sternum is seen nearly always as a complication of a more or less generalized lymphadenomatous process. Ziegler states, however, that in rare cases the osseous involvement may be the first evidence of the disease.

Since there are no lymphatic structures in bone, we must consider the process as one of a metastatic nature, or as a direct extension from continguous lymph glands.

Clinically, there is lymphomatous involvement of one or more groups of glands (the mediastinal gands are not necessarily enlarged) followed by tumefaction in the region of the sternum which may or may not be painful. A destructive process in the bone can usually be demonstrated by roentgen examination.

Response to irradiation is characteristic, and may be recommended as a diagnostic measure when lymphoblastoma is suspected. A dose sufficient to diminish the size of the enlarged lymph glands will have the same effect on the sternal tumor.

The technique which we have elaborated in the irradiation of lymphoblastoma has been fully described in an earlier paper.[1] A brief résumé will be given here.

The factors used are 200 kv., 50 cm. focal skin distance, 0.5 mm. copper plus 1.0 mm. aluminum filter, 4 or 5 ma. An effective wave length of 0.155 Å is thus obtained; 1200 E.S.U. seconds gives a mild erythema, measured with the patient in place, and using a field of 400 square centimeters. We have given up the use of the lower voltages in this condition.

By the administration of small daily treatments, $\frac{1}{8}$ to $\frac{1}{3}$ of an erythema dose until a total to $\frac{1}{2}$ to $\frac{2}{3}$ of an erythema dose has been given to one area, it is possible to avoid roentgen sickness in practically all cases.

It has been our experience that patients may be satisfactorily treated in this manner over a period of several years without producing the slightest visible effect on the skin.

As has been stated, the osseous lesions respond readily to irradiation, and their presence seems in no way to affect the prognosis of this usually fatal disease in which we can do so much to mitigate, but so little to cure.

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METASTATIC CARCINOMA IN BONE*

REPORT OF TWO UNUSUAL CASES

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NO attempt has been made to treat here exhaustively of metastatic carcinoma in bone. The roentgenograms of the spine and pelvis in two recent cases were so unusual in their appearance that it was considered of sufficient general interest to report them. No previous report of a similar case was found in the English literature.

CASE HISTORIES

CASE I. (Fig. 1) C. F. R., a married, white American woman, fifty-two years of age, was admitted to the orthopedic service of the Massachusetts General Hospital, Dec. 30, 1925, complaining of pain in the lower back and sacroiliac regions which radiated down both thighs.

Her family and past history was essentially negative.

Her present illness began two and a half years previously when she noticed a small lump, about 1 × 0.5 cm. in the under side of her right breast. It was freely movable and painless. After a year of quiescence the lump began to grow rather rapidly until it was about 5 cm. in the greatest diameter. Her physician advised an immediate operation. The tumor was resected by the conservative method elsewhere in November, 1924.

She was told that the growth was a "fatty tumor in a sac." Two weeks after returning home she began to suffer with pain and stiffness in her neck. She also noticed new lumps, which grew quite rapidly, above both clavicles, the right side of her neck and in the right axilla. There was also severe pain in her back and sacroiliac regions. This was not unlike the "sciatic" pains from which she had suffered ten years previously. The pain was quite constant and radiated around the hips and down the thighs. It was stabbing and made her cry out. She had not attended to her household duties on account of the pain. She sought relief from pain in another hospital, where a microscopic examination of one of the axillary glands showed recurrent carcinoma of the breast. Here she received a series of short wave roentgen therapy, to which she reacted badly.

On her admission to the Massachusetts General Hospital she gave the impression of one having suffered greatly. She looked cachectic and was anemic. Hard, palpable glands were found in both supraclavicular fossae, the cervical and axillary regions. The right breast had been amputated by the conservative method. The scar area was covered by a dry, fungoid growth. The left breast was negative. The usual laboratory examinations showed nothing remarkable except a low hemoglobin (65 per cent) and low white cell count (3,700). On account of the patient's severe back pain a tentative diagnosis of "acute sacroiliac strain" was made and roentgen-ray studies of the spine and the sacroiliac region of the pelvis were requested.

The roentgenologic examination revealed an interesting picture. There were multiple areas of extreme, increased density in the bones of the spine and pelvis. The areas were quite large and unevenly distributed with indefinite borders. There were none of the fine ring-like shadows usually seen in metastatic malignant disease of the destructive type. The process obscured the normal bone markings, giving a shadow of homogeneous increased density. They appeared in the borders of several vertebrae, in the ilia, along the sacroiliac joints, and in the necks of the femurs. The bones were not enlarged nor deformed. There was an anatomical variation in the fifth lumbar vertebra probably of no special significance. The humeri, the distal long bones and the skull showed no evidence of the process noted in the flat bones. Microscopic examination of a specimen removed from the region of increased density in the ilium of the first patient showed it to be "cirrhotic carcinoma."

CASE II. (Fig. 2) M. C. M., an unmarried, white American woman, forty-four years of age, was admitted to the Massachusetts General Hospital, Nov. 21, 1922. She was referred by her family physician for diagnosis and treatment of lump in the left breast.

Her family and past history was negative.

About one year previous to her admission she noticed a small lump in the left breast which was painless and freely movable. Because there was no pain, no thought of cancer came to her mind, and only accidentally did she mention it to her family physician.

Physical examination showed a large lump in the left breast measuring 5 cm. in the greatest diameter. The nipple was adherent, the

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skin retracted on the lower margin, and glands in the left axilla were palpable. The right breast was negative.

A complete amputation of the left breast with dissection of the axillary glands was done Nov. 22, 1922.

The pathologic examination of the specimen showed a large, fibrous tumor 5.5 cm. in diameter without definite outlines. The remainder of the breast was fibrous and shotty, with an occasional small cyst. Three hard lymph nodes, the size of cherry pits were found in the axillary fat. A microscopic examination of the tumor showed strands and clusters of small, atypical epithelial cells in a variable amount of reactionary fibrosis. A section of one of the lymph nodes showed it to be extensively invaded by cells of the same character. There

FIG. 1. Case I. Shows a rare form of metastasis. There are large areas of increased density throughout the bones of the lumbar spine and pelvis. Note the complete absence of bone destruction.

was atrophy of the adjacent breast tissue. Some of the small ducts were filled with atypical epithelial cells. A small area of the skin, on microscopic examination, showed perivascular infiltration about the small vessels in the corium. No evidence of malignant disease in the skin. Diagnosis: Carcinoma of the breast with metastasis to the axillary lymph nodes.

Ten days after the operation the patient received the usual prophylactic roentgen-ray therapy to her chest and left axilla. The series was repeated in June, 1923, six months after the first series.

A local recurrence in the form of small, pea-sized, red, firm nodules was observed December, 1923. Chest films showed no evidence of metastasis. The recurrence was successfully treated by short wave irradiation.

However, a vesicular eruption developed in the left axillary line about the region of the eighth rib, and extended toward the mid line. Intense pain and itching accompanied the eruption. It had the characteristic appearance of herpes zoster. This is a complication occasionally observed after intensive irradiation.

In July, 1925, there was a second recurrence of skin nodules as noted eighteen months previously. The chest was still free from meta-

FIG. 2. Case II. Shows a less extensive lesion than that shown in Figure 1. The sacrum, and the lumbar vertebrae are involved. There is no evidence of bone destruction.

stasis. Energetic medium wave irradiation caused the complete disappearance of the skin nodules, followed by a well-defined erythema.

In January, 1926, the patient returned complaining of pain low in the back. There was no recurrence of the local lesion. Films of the chest were negative. The roentgenologic examination of the pelvis and spine showed multiple areas of increased density in the bone. The areas were quite large and unevenly distributed in the sacrum, the left ilium, the first, third, fourth, and fifth lumbar, and fifth dorsal vertebrae. The lesions presented the same characteristics as noted in the first case.

Metastasis in bone from carcinoma is not uncommon and its appearance has been described by Pfahler,[1] Moore,[2] and others. The characteristic forms show an irregular moth-eaten appearance of the bone with little or no evidence of reaction (Fig. 3). These areas vary considerably in size, shape and distribution. They may be localized or widely diffused, and their borders well defined or indefinite. More commonly we see ring-like shadows of diminished density surrounded by a varying amount of increased density in bone. The osseous tissue reacts to the invading cancer cells and attempts to limit their growth.

Apparently the extent of the reaction depends upon the relative malignancy of the primary tumor. The more malignant ones show very little bone production. On the other hand, there is in the slowly growing carcinoma very little disposition to metastasize. However, when metastasis does take place, the hyperplasia of bone is out of proportion to the destruction (Fig. 4).

The symptomatology of metastatic carcinoma is rather vague. Pain is the most common symptom complained of. It is usually of a dull character. It may be excruciating and may prevent sleep. When located in the lumbar spine and pelvis the pain often radiates down the thighs and sometimes around the hips. However, pain is not a constant symptom of metastasis. It is not unusual to find extensive metastasis in the chest from either carcinoma or sarcoma without the least subjective symptoms.

The two cases reported represent an unusual type of metastasis in bone. The roentgen-ray picture is so unusual as to attract immediate attention. The bones of the pelvis and the lower lumbar spine show areas of extreme density, as above described. There is no roentgen-ray evidence of bone destruction.

The condition in the first patient was discovered quite accidentally. She was referred from Orthopedic Service to ascertain the cause of pain in the sacroiliac region. The other patient was referred from the Tumor Clinic with a frank suspicion of metastasis in the lumbar spine. She had received several series of postoperative, short wave roentgen irradiations which had for a time controlled the local recurrences. Pain in her back and sacroiliac regions aroused a suspicion of the presence of metastases.

FIG. 3. The common form of bone metastasis from carcinoma of the breast. The ring-like shadows of diminished density are well shown in the pelvic bones. Bone destruction exceeds bone production.

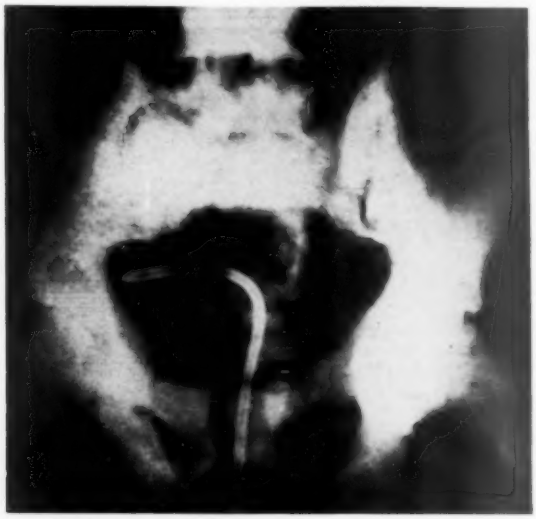

FIG. 4. Shows marked bone proliferation, associated with slight bone destruction. Secondary to carcinoma of the prostate and represents the so-called scirrhous form of metastasis.

About two and a half years elapsed from the recognition of the primary lesion to that of metastasis in the first patient, and about four years in the second.

Neither of the patients showed any evidence of pulmonary metastasis.

DIFFERENTIAL DIAGNOSIS

There is a very close similarity between this type of hyperplastic metastasis and the so-called "marble-bones" disease. This is an extremely rare condition. Alexander[3] has reported one case in a married woman, forty-three years of age, which was discovered accidentally in the course of an examination for a possible fracture of the right hip. The fracture had resulted from a very slight twist. The patient gave a history of a fracture of the left hip twelve years previously, also the result of a trivial accident. The roentgen-ray findings peculiar to this disease are the following:

(1) Extraordinary increase in the lime content of the bones, the increase being uniform in the flat as well as in the long bones. Practically the entire osseous skeleton is involved.

(2) Notwithstanding this increase in density, the bones are characterized by extreme fragility so that fractures are sustained as a result of trivial accidents. All of the cases reported presented one or more fractures. Healing of the fractures is extremely slow.

(3) The medullary canal and the spongy portion of the bones are converted into compact bone.

(4) The structural contour of all the bones is preserved. Arthritic changes in the spine and other joints are conspicuous by their absence. The joint spaces are well maintained and there is no destruction of the joint cartilage. The underlying cause of this extradordinary condition is obscure. A profound metabolic or endocrine disturbance is probably responsible.

The other condition which may cause difficulty in diagnosis is that of Paget's disease, or osteitis deformans.[4] In this disease there is marked thickening and, in the later stages, bowing of the long bones. The trabeculae rearrange themselves into longitudinal strands and bundles forming small rectangles. Carcinoma never shows this picture. The involved areas are either uniformly dense, or show small ring-like shadows of rarefaction in the bone with a peripheral condensation. The changes in the skull are quite characteristic in Paget's disease; there is expansion of the cranial bones with thickening of both tables and a coarse mottling throughout the diploë. The lesions in carcinoma are more circumscribed and there is absence of thickening and expansion.

It is rather common for Paget's disease to extend to the bones below the elbows and knees. Carcinoma very rarely, if ever, metastasizes to these regions.

SUMMARY

1. Two cases illustrating an unusual form of metastasis in bone from carcinoma of the breast are reported.

2. The roentgenographic appearance of the common forms of metastatic carcinoma is briefly described.

3. Attention is called to an unusual manifestation of malignant metastasis in which there is complete absence of bone destruction, and the lesions are represented by hyperplasia alone.

4. Pain in the bones or joints, of a rheumatic character, in patients suffering from any form of malignant disease should at once arouse suspicion of metastasis. Not only the region complained of but also the entire skeleton should be thoroughly investigated.

5. The principal points in the differential diagnosis of this hyperplastic type of metastasis from the so-called "marble bones" disease and osteitis deformans are cited.

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DIFFUSE VERTEBRAL METASTASIS OF PROSTATIC CARCINOMA WITHOUT BONY CHANGES*

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OF the malignant neoplasms which exhibit a predilection for osseous metastasis, carcinoma of the prostate gland probably exceeds all others in point of incidence. Carcinomas of the breast and thyroid gland, and renal and adrenal hypernephromas likewise frequently give rise to bone metastasis. In the experience of this laboratory there have been as many cases of prostate carcinoma with osseous metastasis as of all the other three types mentioned above added together. Blumer[1] says that two-thirds of prostate carcinoma cases which run an unobstructed course will ultimately show bone metastasis. In his experience, secondary tumors were found in bone in 50 per cent of hypernephroma cases, in 25 per cent of thyroid carcinomas, and in 14 per cent of breast cancers. In 22 cases of prostate carcinoma in which the bones were examined completely at autopsy, Kaufmann[2] found bone metastases in 16, an incidence of 72 per cent. Bumpus[3] found bone metastases, demonstrable by roentgen rays, in 30.3 per cent of 135 prostate cancer patients. In a later paper, Bumpus[4] found that 30.26 per cent of 228 prostatic carcinoma patients, examined roentgenographically, showed metastasis. Of 153 pelvic films, 46 were interpreted as showing metastasis (30 per cent). Of 154 spinal films, 40 (25.97 per cent) showed evidence of metastasis. In 140 lung films, 8, or 6.4 per cent, gave characteristic findings of metastasis. In 141 rib examinations, 8, or 5 per cent, revealed bony changes indicating secondary growth. In but 7, or 5.7 per cent, of 122 femoral films were metastases demonstrable. Bumpus emphasizes the value of routine roentgenographic examination of the lower spine, pelvis and upper femur (one film) in all cases of suspected prostate carcinoma. In his experience lung films are usually of little value because when pulmonary metastases are demonstrable, osseous metastases will invariably be found. Of the bones which exhibit this striking localization of prostate carcinoma metastasis, the pelvic bones, vertebrae (particularly the lumbosacral), and femora are by far the most commonly involved, in the order named.

To von Recklinghausen[5] we owe our gratitude for the first satisfactory description of the peculiar type of bone involvement which characterizes most metastatic prostate growths. In 1891, he described his necropsy findings in 5 cases of primary prostate carcinoma with bone metastasis. There was but little or no bone deformity, and on gross examination the areas of metastasis were firm and white, with no bone destruction. On microscopical study, many large, newly formed bone trabeculae were found in these areas, as well as spicules of old bone undergoing slow absorption. The new bone trabeculae were found to surround nests of columnar cell carcinoma of the same type as those seen in the primary prostatic neoplasm. Von Recklinghausen considered, and dismissed, the possibility that the process was one of concomitant hypertrophic osteitis, or that it was one of simple petrification. The occurrence of this peculiar osteogenesis was interpreted by him as being a reaction to the presence of the heteromorphic whirls and strands of carcinoma cells. Because of the remarkable bone-forming tendencies of this neoplasm, he gave to it the name "osteoplastic carcinoma." Since this original designation, many other workers have emphasized the same pathological features of metastatic prostate carcinoma in bones. Kaufmann[2] found osteoplastic metastasis in 14 of 16 cases of prostate carcinoma with secondary growths in bones.

It is probable that the occurrence of this osteogenic phenomenon in bone metastases of scirrhous carcinoma of the prostate gland is to be explained by the origin of the stroma of the metastatic scirrhous

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carcinoma from endosteum. The stroma which is found associated with the metastases of such scirrhous carcinomas develops *in situ*. The exuberant stroma reaction which is called out by the presence of metastatic scirrhus in bones is, then, produced by the proliferation of endosteal connective tissue with natural bone-forming tendencies. The presence of the carcinoma cells undoubtedly acts as the stimulus which excites osteogenesis. If this simple theory should suffice to explain osteoblastic proliferation in the case of scirrhous prostatic carcinoma metastasis to bones, it would appear that it should be similarly applicable to the bone metastases of scirrhous carcinomas arising elsewhere, notably in the breast. Von Recklinghausen[5] drew a close analogy between carcinomas of the prostate gland and those of the female breast, not only as to their morphologic similarity, but as to their proneness to develop osteoplastic bone metastases. Ewing[6] says, "Similar osteoplastic processes are observed, especially with mammary carcinoma, and with tumors of the stomach, gall-bladder, thyroid, etc., but the early and frequent occurrence and extensive distribution belong chiefly to the prostatic disease."

Stewart[7] believes that the character of the primary prostate growth can be diagnosed by the roentgenographic appearance of its osseous metastasis. He agrees with Phemister, whom he quotes, that the osseous metastasis of prostatic carcinoma assumes the morphological characteristics of the primary growth. If the stroma predominates in the primary neoplasm (scirrhous carcinoma), a condensing or osteoplastic form of metastasis is bound to result, with increased density, obliteration of normal bone markings, and a resultant dense black shadow. On the contrary, if the primary carcinoma be medullary, the secondary osseous growth should be of the rarefying or "osteoclastic" type. Bumpus,[3] in a study of 362 cases at the Mayo Clinic, found that the osteoplastic type was by far the more common, but that osteoclastic changes did occur in a minority of his cases. All writers agree that in bone metastasis of prostate carcinoma the tendency towards bone formation is out of all proportion to bone destruction. These observations are supported by the relatively high incidence of primary scirrhous of the prostate gland as compared with the medullary carcinomas. Among 274 surgically removed prostate glands, examined histopathologically in this laboratory during the past five years, there were 44 primary prostatic carcinomas—an incidence of 16 per cent, or approximately one case of carcinoma to every six of benign glandular hyperplasia. Even this appalling figure is not representative because many carcinoma cases were refused operation. Of the 44 carcinomas, 32, or 72 per cent, were frankly scirrhous. And among the remaining 12 carcinomas, which were chiefly medullary in type, areas with scirrhous structure were frequently encountered.

In view of the fact that medullary prostate carcinomas, both in the primary growth and in the metastases, frequently show areas which are of scirrhous architecture, it seems reasonable to conceive that in certain instances, the roentgenogram should reveal both osteoplastic and osteoclastic changes in the bones.

It is beyond the scope of this present undertaking to conduct a full discussion of the pathology of bone metastases of prostate carcinoma. The purpose of this paper is to direct attention to a third form of metastatic prostate carcinoma, which does not conform either to the osteoplastic or the osteoclastic type. That this form must be rare is indicated by the writer's inability to find any reference to a similar case in the literature on prostate carcinoma. It is of particular interest to the roentgenologist because it presents a new problem in the diagnosis of extensive vertebral metastasis of a carcinoma primary in the prostate gland.

A brief clinical abstract of an illustrative case follows.

CASE REPORT

Mr. A. P., aged sixty-nine, entered the Surgical Clinic of the University of Michigan Hospital, service of Dr. Hugh Cabot, on Jan. 8, 1925, complaining of pain on urination, associated with frequency and dribbling. At the time of admission, he urinated about every

two hours during the day and night. The urinary stream lacked force and was small in size. He had never been catheterized and had had no hematuria. During the last few months he had failed in weight and strength.

Physical examination revealed an emaciated, senile individual, who appeared to be in some distress. The eyes showed marked arcus senilis. The pupils were round, equal and regular, and reacted normally to light and accommodation. The lungs were negative. The heart sounds were weak and distant. There were no thrills or murmurs. The heart was not enlarged and the cardiac rate and rhythm were quite normal. The peripheral arteries were tortuous and

FIG. 1. Lumbar spine and pelvis, with no evidence of metastatic neoplasm.

had very much thickened walls. The abdomen and extremities presented no abnormalities.

On rectal examination, the prostate gland was found to be about three times normal size, firm, with a smooth outline, and the lateral sulci well-preserved. The bladder held three ounces of residual urine. The blood nonprotein nitrogen was 38.2 milligrams per 100 cubic centimeters. The blood Wassermann report was negative.

The report from the Department of Roentgenology, service of Dr. Preston M. Hickey, was as follows: "Stereoscopic films of the lumbar spine and pelvis (Fig. 1) show marked hypertrophic changes, with spicule formation on the edges of the articular surfaces of the bodies of the vertebrae. There is also evidence of an old subluxation of the 4th lumbar vertebrae on the 5th. There is no increase in density in any of the vertebrae or sacrum which would suggest metastasis from a prostate carcinoma. We note marked calcification of the iliac vessels. We report no evidence of metastatic neoplasm in the bony structures of vertebrae or pelvis."

Clinical Course. The patient was admitted to the ward with a diagnosis of carcinoma of the prostate gland, with urinary retention. An indwelling urethral catheter was inserted to establish constant drainage. The patient promptly developed an acute epididymitis with an elevation of temperature. The inflammation subsided somewhat after suspension of the scrotum and the use of cold applications. Improvement was slow and unsatisfactory, however, and it was thought advisable to drain the bladder suprapubically by means of cystostomy. On Jan. 17, a cystostomy was performed under local anesthesia. At this time, intravesical examination revealed a definitely carcinomatous prostate gland.

Four days later, a severe earache developed, with mastoid tenderness and a temperature of 102°F. The ear drum ruptured spontaneously and led to free drainage. The patient continued to grow weaker and became dyspneic. He died on Jan. 23, 1925, at 9 A.M.

Clinical Diagnosis. Carcinoma of the prostate gland, generalized arteriosclerosis, senility.

Autopsy. Prosector, Dr. Simpson. A summary of the important features at the autopsy follows:

The body was that of a markedly emaciated, senile man who appeared older than the stated age. In the midline of the abdomen, between the umbilicus and symphysis pubis, was a recent surgical incision, measuring 9 cm. in length; slight healing had occurred; seven sutures were still in place. The ribs and sternum were osteoporotic, with moderately abundant pale reddish-brown marrow, and showed no evidence of neoplasm. The heart was not enlarged. Over the right ventricle and near the apex of the left, was a well-marked fatty infiltration, the fat showing serous atrophy. The right ventricular wall measured 6 mm. in thickness, of which 4 mm. were composed of fat. The endocardium throughout showed a well-marked tiger heart. There was considerable relaxation of the tricuspid ring, the orifice admitting four fingers readily. The aortic valve flaps were stiff and thickened. The lungs showed large emphysematous areas; no pneumonia nor neoplasm. The bronchial nodes showed many caseating and calcifying tubercles. The aorta

was very atherosclerotic, with many small atheromatous ulcers and extensive calcification. The abdominal viscera were atrophic and careful examination revealed no neoplasm. The kidneys were larger than normal. Scattered over the renal surface and through the parenchyma were many small yellowish-gray areas, averaging about 3–4 mm. in diameter; these contained pus. Extending from the renal pelvis up into the cortex were radiating yellowish-gray streaks. Surrounding these streaks and the small abscesses was a zone of intense hyperemia. The renal pelves were thickened and much inflamed; the mucosa showed patchy ulceration with a fibrino-purulent membrane covering the denuded areas. The pelves contained a small amount of free pus. Both ureters were thick-walled and contained pus.

Overlying the third and fourth lumbar vertebrae was a firm, grayish mass, measuring 8 cm. in length, 4 cm. in width, and from 1 to 2 cm. in thickness. Scattered through this neoplastic mass were multiple roundish areas of soft consistence. On scraping, the cut surface yielded abundant, milky "cancer juice." The neoplasm had completely replaced the lymphoid tissue of the retroperitoneal lymph nodes in this region. The mass was quite adherent to the vertebrae on the left side, but the cortex of the vertebral bodies was smooth and showed no gross infiltration with neoplasm.

Upon examination of the pelvic structures, the prostate gland was found to be entirely made up of medullary new growth. No distinct lobes could be distinguished. The capsule was irregularly infiltrated with neoplasm, and was firmly adherent to all the surrounding structures. On the right side, the mass was of firm consistence, but elsewhere there were many large, soft, very cellular areas, rich in yellowish-white tissue juice, very similar in appearance to the retroperitoneal mass described previously. The prostatic new growth was separated from the rectum by a dense fascial layer. There was no infiltration of the rectal wall. The seminal vesicles, however, were infiltrated throughout with neoplasm. On the left side of the urinary bladder, posteriorly, in the region of the trigone, were several soft whitish nodules, which, on section, presented the same characteristics as the neoplastic tissue described previously. These nodules had extended entirely through the wall, and had produced ulceration of the bladder mucosa. The ulcer was covered with a thick, grayish-brown diphtheritic membrane. The entire bladder mucosa was covered with a fibrinous and hemorrhagic pseudomembrane. The recent

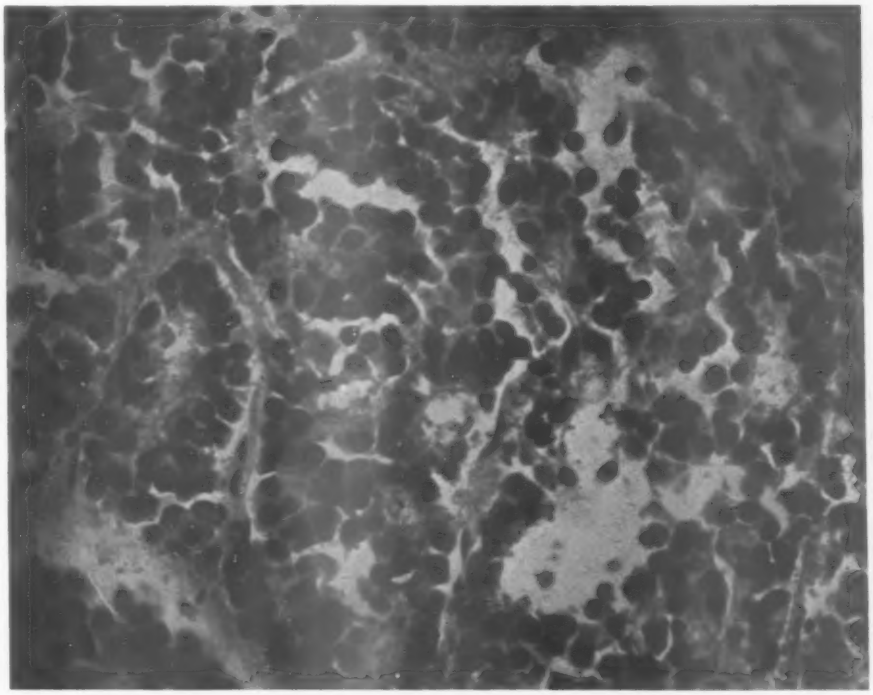

FIG. 2. Metastatic medullary adenocarcinoma in retroperitoneal lymph node. (Hemalum and eosin stain. Zeiss objective AA; compensating ocular number 4.)

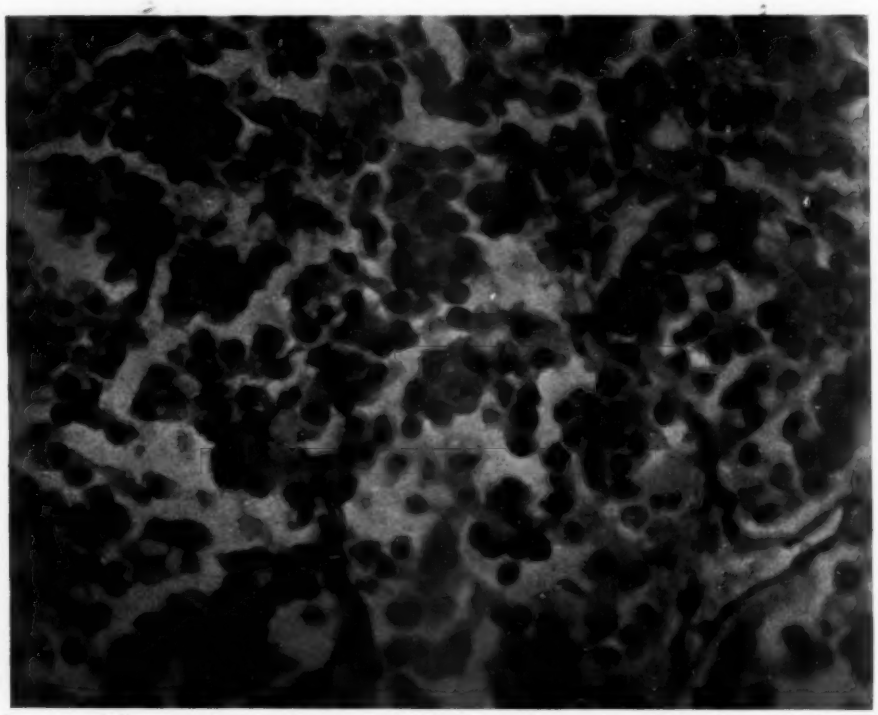

FIG. 3. Primary medullary carcinoma of prostate gland, showing large nests of neoplasm cells with scant stroma.

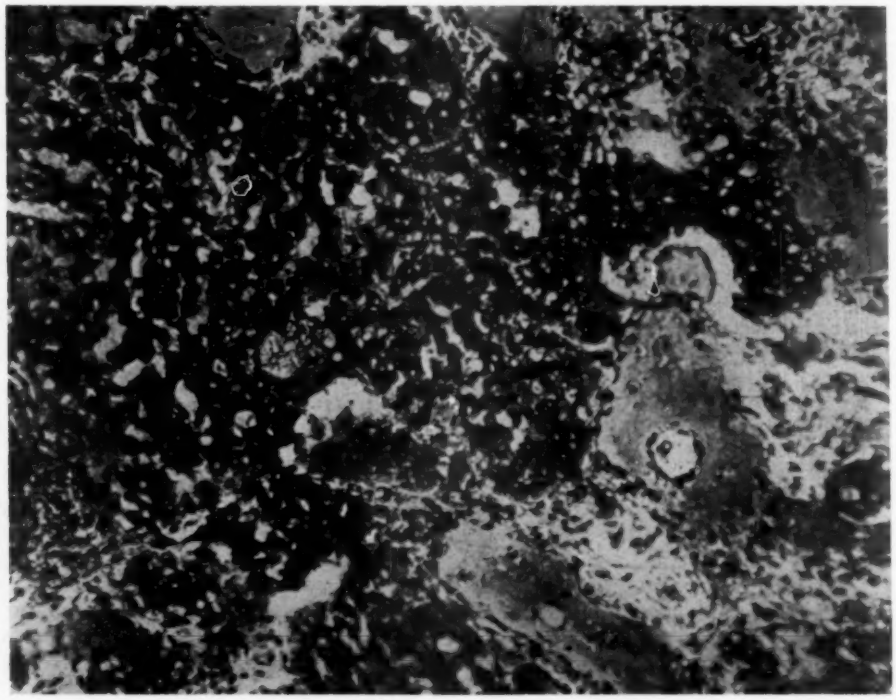

FIG. 4. Low power photomicrograph of decalcified vertebra, showing extensive replacement of the marrow spaces with carcinoma cells, without bony changes.

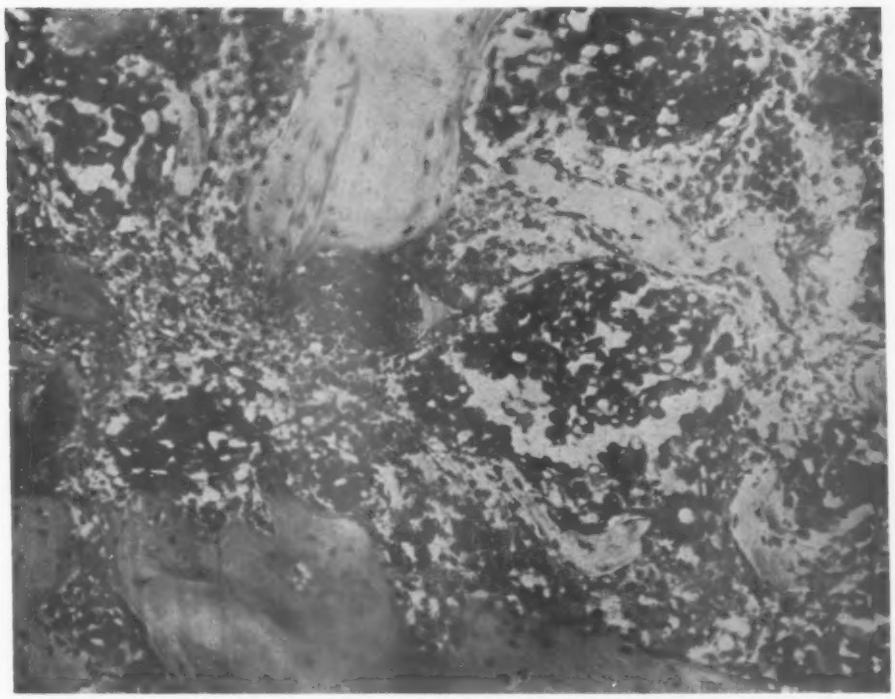

FIG. 5. Another low power study of lumbar vertebra, showing neoplasm cell nests in marrow spaces.

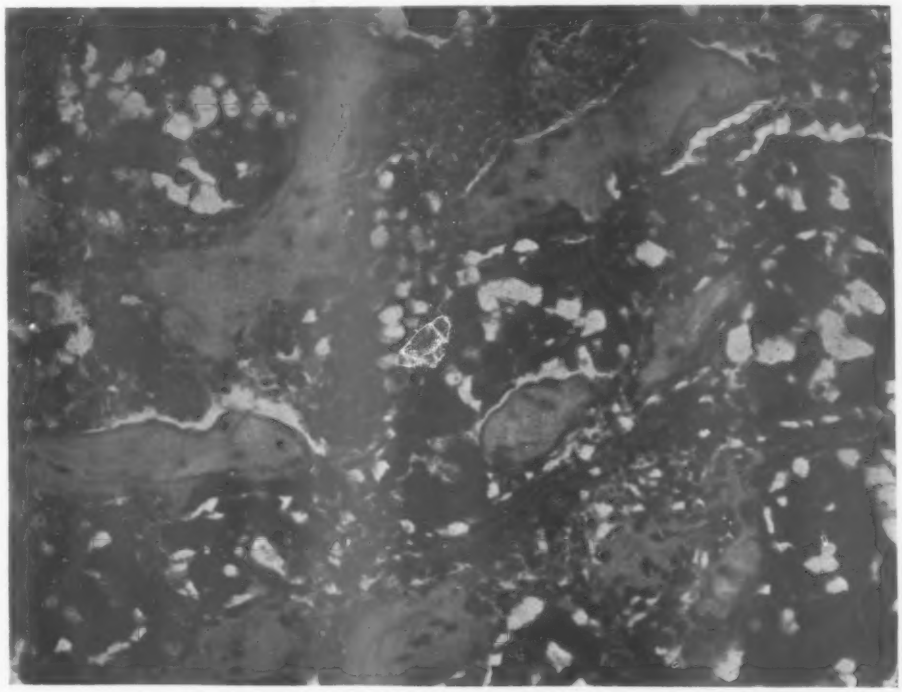

FIG. 6. Diffuse carcinomatosis of lumbar vertebra, showing medullary masses of neoplasm cells almost completely filling marrow spaces. Intact bone trabeculae. (Decalcified bone section. Stained with hemalum and eosin. Zeiss B objective, without ocular.)

surgical wound was found to continue through the abdominal wall and to open into the bladder through an incision, 3 cm. in length, in the antero-inferior bladder wall. The prostatic urethra was constricted by the neoplasm. The urethral mucosa showed no evidence of invasion by the neoplasm. In the periprostatic venous plexus were many small phleboliths. At the upper pole of the right testis was an area of purulent softening about 1 cm. in diameter. The globus major of the right epididymis likewise was the site of an abscess of approximately the same size as that in the testis, with many smaller recent abscesses scattered throughout the body of the epididymis.

The vertebrae and pelvic bones were carefully examined for evidence of direct extension of the neoplasm through the cortices. The periosteum was smooth and shining throughout and the cortex was everywhere intact, with no evidence of direct neoplastic invasion. With the exception of a moderate degree of bone proliferation at the margins of the bodies, and slight rotation of the body of the fourth lumbar vertebra on the fifth, there was no deformity of the vertebrae. Multiple cross-sections, at one-half centimeter intervals, were made through the lower four dorsal and the five lumbar vertebrae. On sawing through the vertebral bodies, normal resistance was encountered. Close inspection revealed no abnormal change in the structure of the cancellous portion of the bodies. The usual number of bony trabeculae were seen, with what was described as a pale reddish-gray marrow between the cancellous trabeculae. The cortex was of normal thickness throughout. The spinal canal showed normal contour. There was no gross evidence of neoplasm. Even though they appeared entirely normal, sections of bone from the dorsal and lumbar vertebrae were saved for decalcification and routine microscopic study.

Microscopic Findings. Routine microscopic study was made of all the organs and tissues (Dr. A. S. Warthin), but only the pertinent findings will be given here:

Heart. Atrophy. Increase of stroma. Subendocardial fatty degenerative infiltration (tiger heart). Subepicardial fatty infiltration with serous atrophy. Early sclerosis of the coronary arteries. The aortic valve shows a marked old sclerosis with calcifications.

Aorta. Advanced atherosclerosis with calcification.

Lungs. Chronic passive congestion. Atrophic emphysema. No neoplasm.

Bronchial Nodes. Anthracosis. Healed miliary tubercles and several active caseating tubercles.

Liver. Brown atrophy. Chronic passive congestion. Leucocytosis. Leucocyte infiltration of islands of Glisson.

Kidneys. Acute purulent pyelonephritis. Multiple small abscesses. Moderate arteriosclerosis. Diphtheritic gangrenous pyelitis in localized areas.

Pelvic Tissues. Diffusely infiltrated with carcinoma, extending up along the vena cava and aorta. Medullary adenocarcinoma of the same type as in the primary prostatic mass.

Lumbar Retroperitoneal Lymph Nodes. (Fig. 2.) Completely replaced by metastases.

Right Testis and Epididymis. Acute purulent epididymitis, with multiple acute abscesses. Acute fibrinous periorchitis. Complete aspermatogenesis. Vacuolization of germ cells. Fibrosis of basement membranes of tubules. Multiple abscesses in body of testis. Acute purulent orchitis.

Prostate Gland. (Fig. 3.) Completely replaced by a medullary adenocarcinoma, infiltrating seminal vesicles, bladder wall and pelvic fascia.

Bladder. Chronic cystitis cystica. Marked formation of cell nests of Brunn. Carcinomatous infiltration of muscularis and of subserous coat. Carcinomatous ulcer with diphtheritic necrosis on the surface. Acute diphtheritic cystitis.

Vertebrae. (Figs. 4, 5 and 6.) Diffuse carcinomatous infiltration, practically replacing the marrow in all areas examined. No destruction of trabeculae. No bone absorption. No bone production.

Pathological Diagnosis. Primary medullary adenocarcinoma of prostate gland with infiltration of seminal vesicles, urinary bladder and pelvic fascia. Multiple metastases in the retroperitoneal lymph nodes. Diffuse carcinomatosis of vertebrae. Septico-pyemia. Acute purulent pyelonephritis. Right-sided purulent orchitis and epididymitis. (Cystostomy.) Chronic hypertrophic cystitis cystica. Tumor cachexia. Atrophy, passive congestion and parenchymatous degeneration of all organs. Advanced atherosclerosis of aorta and of mitral and aortic valves. Old adhesive pleuritis. Emphysema. Brown atrophy of liver. Terminal right-sided dilatation and insufficiency of heart. Tubercles in bronchial nodes.

COMMENT

As regards the vertebrae, the clinical, roentgenological and gross pathological evidence was in entire accord. There was no gross anatomical evidence of carcinomatous metastasis to the spine. But upon microscopic examination of the decalcified

vertebral bodies, the several members of the pathological staff who had witnessed the necropsy were amazed to discover that the marrow spaces of all sections examined were filled with carcinoma cells. In fact, the marrow substance was practically replaced by medullary carcinoma, exhibiting no tendency to produce either bone proliferation or bone destruction. The carcinomatosis was uniformly diffuse throughout the lower dorsal and lumbar spine, the body of the eighth dorsal vertebra showing as massive metastasis as did any of the lumbar vertebrae. Therefore, this form of prostate carcinoma metastasis to bone does not conform either to the common osteoplastic type or to the less frequent osteoclastic type.

In view of the fact that it is the medullary type which apparently produces the destructive, osteoclastic bone metastases, it is conceivable that had this patient lived longer, bone destruction and absorption might have resulted. The carcinoma cells in the marrow spaces appeared young. In all probability there had been recent dissemination of the carcinoma cells throughout the vertebral marrow, and quite probably into the marrow spaces of the pelvic bones as well. The important lesson to be learned from this case, then, is that it is possible in certain cases, for generalized osseous carcinomatosis to occur, which is grossly and roentgenographically unrecognizable.

It is of further interest to learn that in this case rectal examination did not reveal the irregular, stony-hard prostate of the textbooks, but was described by the experienced genito-urinary surgeon as being three times normal size and possessing a smooth outline, with distinct preservation of the lateral sulci. This coincides with the necropsy findings in this case, in that much of the gland was soft (medullary), and the firm fascial sheet which separates the prostate gland and seminal vesicles from the rectum (the so-called "fascia of Denonvillier") was not invaded. This fascia acted as a taut, limiting membrane, which probably contributed to the smoothness of the prostatic contour posteriorly. It seems reasonable to conceive, then, that many medullary carcinomas of the prostate gland should be large, smooth, and softer in consistence than the classical "rock-like" gland, so commonly encountered on digital examination per rectum.

It might be desirable to emphasize again the extensive skeletal metastasis, without pulmonary involvement, so beautifully demonstrated by this case.

SUMMARY AND CONCLUSIONS

1. A case in which a medullary carcinoma of the prostate gland gave no clinical, roentgenographic, or gross anatomical evidence of vertebral metastasis, is reported. Subsequent microscopical study of decalcified bone sections from the vertebral bodies, revealed generalized vertebral carcinomatosis, without bone destruction or bone proliferation.

2. There is, then, a third form of osseous metastasis of prostatic carcinoma, presumably rare, which does not conform to either the common osteoplastic (osteoblastic), or to the less common osteoclastic type.

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ROENTGENOLOGIC DIAGNOSIS OF BENIGN AND MALIGNANT GASTRIC TUMORS IN ONE PATIENT*

BY LEO G. RIGLER, M.D.

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THE diagnosis of benign gastric tumors is being reported more frequently as the roentgen examination of the stomach is done more routinely. The roentgen diagnosis of carcinoma of the stomach is now one of the most accurate procedures in medicine. The coincidence of benign polypi and carcinoma in the stomach is not at all common, although it has been found with sufficient frequency in post mortem examinations to give rise to the theory that carcinoma may arise from a polyp. I have been unable to find, however, a record of any case in which both benign polyp and carcinoma in the same stomach have been diagnosed, either clinically or roentgenologically.

The following case report is, therefore, of considerable interest as two tumors, one benign and one malignant, were recognized on roentgen examination and confirmed by autopsy. The lack of relationship between the two is also well shown.

CASE REPORT

O. W., a white male, aged sixty-seven, entered the Minneapolis General Hospital, April 18, 1925, because of a carbuncle in the posterior cervical region. On examination he was found to have a glycosuria and hyperglycemia so a diagnosis of diabetes mellitus was made. In the course of the routine history and blood examination it was found that he had lost considerable weight and had a profound secondary anemia. Although there were no gastric symptoms whatever, the possibility of a carcinoma of the stomach was considered and the patient was sent to me for barium meal examination of the gastrointestinal tract.

FIG. 1. Roentgenogram of the stomach showing the extensive polypoid carcinoma of the cardia. The lower arrow points to the benign polyp of the antrum. The area of normal stomach between the two tumors should be noted.

FIG. 2. The defect caused by the benign polyp in the antrum is well shown. Note the peristaltic wave about to pass through the region of the tumor.

The roentgen examination revealed a large, rather polypoid type of infiltration on the

* From the Department of Roentgenology of the Minneapolis General Hospital; presented before Hennepin County Medical Society, Feb. 10, 1926.

posterior wall and lesser curvature of the cardiac portion of the stomach, extending well up to the left diaphragm, but well localized to the cardiac third, and characteristic of carcinoma. The middle third of the stomach was normal showing vigorous peristalsis which passed through without hindrance. The pyloric third also showed normal peristalsis and normal contours, except for a small, round, smooth-edged, regular filling defect on the posterior wall of the antrum, just prepyloric in situation. No mass could be palpated and peristalsis passed through it without hindrance. A second examination confirmed these findings which are well shown in Figures 1 and 2. The area of normal stomach between the two tumors and the passage of peristalsis through the region of the smaller tumor should be particularly noted. A diagnosis of inoperable, polypoid carcinoma of the cardiac portion of the stomach, and benign polyp of the antrum was made.

The patient left the hospital May 23, 1925 against advice, but returned on Dec. 22, 1925, just seven months later. He showed evidence of extensive metastases in the liver at this time and he died Jan. 20, 1926.

Post mortem examination by Dr. Kano Ikeda revealed the following pertinent findings. There were numerous nodular metastases in the liver and extension of the carcinoma into the tail of the pancreas and the surrounding glands.

The stomach showed an irregular, soft, cauliflower-like growth at its cardiac end, on the posterior wall and lesser curvature. The central portion of this was necrotic. Below this was an area of normal mucosa. Just at the pyloric ring on the lesser curvature was a grape-like, soft, polypoid growth, about 1 cm. in diameter, sharply demarcated, with no ulceration or induration at the base. It extended out from the mucosa into the lumen of the stomach and was not connected intimately with the muscularis of the stomach. Section from the growth at the cardiac end revealed adenocarcinoma, while section of the tumor of the antrum revealed a benign mucous polyp.

Several facts of importance should be emphasized. The lack of gastric symptoms, as shown in this case, is characteristic of carcinoma of the cardiac portion when it does not obstruct the esophagus, and it can often only be diagnosed roentgenologically. The diagnosis of benign tumors can rarely be made in any other way. The passage of peristalsis through the region of the benign tumor and the failure to palpate a mass are characteristic and are due to the lack of involvement of the muscular wall of the stomach. The complete absence of any relationship between the two tumors and the failure of the benign polyp to change appreciably in size in the eight months is also of importance. The presence of two tumors in one stomach, one benign and one malignant, is unique.

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THE AMERICAN RADIUM SOCIETY

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Twelfth Annual Meeting: Washington, D. C.

Committee on Arrangements: TRUMAN ABBE, Chairman, Washington, D. C.; C. AUGUSTUS SIMPSON, Washington; ERNEST N. DORSEY, Washington.

EDITORIALS

ORAL ADMINISTRATION OF TETRAIODOPHENOLPHTHALEIN

A paper by Dr. William H. Stewart of New York on the above subject, which was read at the recent annual meeting of the American Roentgen Ray Society in Detroit, stimulated much interest. Dr. Stewart has received many inquiries with regard to his technique and it seems advisable to publish it here in advance of the publication of his complete paper. Dr. Stewart has furnished the Editor with the following description of his technique:

"For the average patient weighing 150 pounds, the contents of one ampule of "iodeikon" (Mallinckrodt) is placed in eight #3 gelatin capsules. Should the patient weigh more than this amount, more capsules are made up from another ampule and given in the proportion of one capsule for each additional 25 pounds of weight. The drug is in sealed colored ampules and its freshness can be relied upon. The ampules are opened only when the patients arrive at the office. After the capsules are filled they are dipped in a solution of keratin and placed on a screen to dry, which takes about ten minutes.

"The formula for the keratin solution is as follows: Keratin, 7 parts dissolved in equal parts of dilute alcohol and 10 per cent aqua ammonia sufficient to make 100 parts."

The technique of preparation and examination is as follows:

"After a thorough cleansing of the intestinal tract, preferably with compound licorice powder given the night before and followed by a simple enema in the morning, a preliminary examination of the gall-bladder is made in the ordinary manner at about 3 P.M. At 6 P.M. the following meal is given: Creamed soup, creamed chicken, baked potato, bread and butter and a glass of milk. The abundance of fat in this food will partially or completely empty the gall-bladder in from one to two hours.

"Beginning at 9.30 P.M., two of the keratin coated capsules are given with a wine glass full of water every fifteen minutes until all are taken. No breakfast is allowed.

"The first films are taken at 9.30 the following morning, that is, twelve hours after administration of the capsules. The patient must abstain from food or liquids until the second films are taken sixteen hours after the administration of the dye. At this period the gall-bladder shadow should be the greatest. Lunch consisting of a chicken sandwich and a glass of milk is then given and another film made one hour later when the gall-bladder should be markedly diminished in size or should have completely disappeared. On the following morning, that is at thirty-six hours, the gall-bladder shadow should have completely disappeared in all normal cases.

"It is our custom at the thirty-sixth hour observation to examine the stomach and duodenum, and it is frequently advisable to continue the examination for the possibility of the existence of adhesions between the gall-bladder and the colon."

We are indebted to Dr. Stewart for the above clear description of his technique and trust that many will give the method a thorough trial and report their results. There is no doubt that cholecystographic examinations will become much more common if the oral method can be relied upon to the extent that Dr. Stewart's communication would seem to warrant.

THE INDEX

A sufficient number of objections to the change in the method of publishing the index instituted at the end of the previous volume has made it seem advisable to return to the original method of publishing the index in the last number of each volume. The index to Volume XV is therefore published in this number of the Journal.

ANNUAL MEETING

American Roentgen Ray Society

Detroit and Ann Arbor, Mich., May 17–21, 1926

This year's meeting of the American Roentgen Ray Society was one of the most successful that has ever been held. The excellent program prepared by Dr. Carman, the entertainment furnished by the local committee, the day's program in Ann Arbor presided over by Dr. Hickey and the unusual excellence of the scientific exhibit all combined to render the meeting most enjoyable and instructive. It was a great disappointment to all that Dr. Carman's illness prevented him from being present to preside at the meeting, every detail of which he had carefully arranged. Although not able to be present at the meeting Dr. Carman was installed as president of the Society for the coming year.

The following officers were elected: President-elect, A. Howard Pirie; First Vice-President, P. F Butler; Second Vice-President, E. L. Jenkinson; Secretary, Charles F. Martin; Treasurer, Wm. A. Evans; Librarian and Historian, H. W. Dachtler; Member, Executive Council, George W. Grier.

THE SCIENTIFIC EXHIBIT

No one attending the recent meeting of the American Roentgen Ray Society in Detroit could fail to be impressed by the unusual excellence of the Scientific Exhibit. In the light of recent discussion regarding the wisdom of continuing this feature of our meetings such a result was particularly agreeable.

The Scientific Exhibit Committee under the leadership of Dr. Reynolds of Detroit are to be highly commended for their accomplishment. An innovation consisted in the award of prizes for the three best exhibits. The decision was made by popular vote of the Society in conjunction with the efforts of a prize committee appointed by the chair.

The first prize was awarded to the Roentgen Department of the Mayo Clinic for a display of pathological specimens of the gastrointestinal tract which were accompanied by roentgenograms of each lesion.

The second prize was given to Dr. L. E. Reynolds of Detroit for original roentgenograms of retropharyngeal abscess. These were accompanied by explanatory drawings which made the interpretation of the negatives exceptionally clear and understandable.

The third prize was given to Dr. Wm. A. Evans of Detroit for a very complete display of roentgenograms illustrating mastoiditis in children. The beauty of these negatives and the demonstration of mastoid cells in infants a few weeks old should prove an inspiration to all attending the meeting.

Of the remaining exhibits it would be unfair to mention any without commending all. Perhaps the most striking and valuable advance noticed in this exhibit was the tendency of each exhibitor to confine his display to one subject. This is undoubtedly a very desirable plan and is bound to make a more vivid and lasting impression on the mind of the average spectator. It is hoped that future exhibits will be carried out on the same plan. In times past, there may have been a tendency among exhibitors to display only their most beautiful plates which would perhaps serve little educational purpose other than as lessons in technique.

Another thought worthy of consideration is the inadvisability of using numerous plates to illustrate the same points when one plate would suffice. The practical result of such a plan is to make the exhibit so large and complicated that it bewilders the spectator and the important points which should be emphasized are lost in detail. A glance at such an exhibit convinces one that he has not sufficient time to study it properly and it is either looked over hastily or passed by altogether.

The Detroit Exhibit was extremely well planned and attractively arranged. It has established a precedent which can be profitably followed in the future.

G. W. Grier.

SYPHILITIC OSTEOCHONDRITIS

In 1870 Wegner[1] gave a description, which has become classical, of the osteo-

[1] Wegner, Georg. On hereditary bone syphilis in young children. *Virchow's Archiv. f. path. Anat. u. Physiol. (etc.)*, 1870, l, 305–322.

chondral lesions of congenital syphilis. They are the lesions which occur only rarely after two and a half years of age, and roentgenologists are not so familiar with their appearance as with that of the later type of lesions which occur from eight to twelve years of age, or even later. The osteochondral or infantile type of congenital syphilis corresponds very closely in its manifestations to those of the secondary stage of the acquired disease, while the later manifestations of the congenital disease are analogous to those of tertiary syphilis.

The most important clinical manifestations of syphilitic osteochondritis are moderate swelling of the contiguous joints, thickening of the epiphyseal regions, pain at night and loss of motion in one or more limbs, called Parrot's pseudoparalysis. With regard to the latter point, Findlay[1] states that "it may be taken as an axiom that loss of power of a limb in an infant under six months of age is due to syphilitic osteitis." Other signs of syphilis may also be present including snuffles, various skin manifestations, saddle nose and a positive Wassermann reaction. The fact, however, that the Wassermann reaction is sometimes negative in these cases and the clinical manifestations not typical, renders the roentgen examination of the bones very important. Bone lesions are present in a high percentage of cases.

The pathological changes which occur in the infantile type of congenital syphilis take place in the regions of the epiphyseal cartilages, particularly of the long bones. The regions most frequently involved appear to be the lower end of the femora and of the bones of the legs and forearms, but any bone may be the seat of the disease.

Turnbull[2] in 1922 minutely described the histological formation of the normal epiphyseal region and the departures from the normal due to congenital syphilis. He showed that the first change to take place is a widening of the provisional zone of calcification in the epiphyseal cartilage due to interference with the invasion of blood vessels, osteoclasts and osteoblasts from the extremity of the diaphysis. The end of the diaphysis then becomes ragged and irregular because of the fact that ossification does take place along some of the vertical vessels that unite the diaphysis with the cartilage. The irregularity in the end of the diaphysis is increased and may become extreme because of the growth of tongues of red marrow from the diaphysis into the cartilage, alternating with tongues of cartilage projecting into the diaphysis. A further stage is the formation of irregular islands of calcification in the epiphyseal cartilage along the transverse chondral vessels. The changes do not involve the epiphysis but they may extend to a considerable distance along the diaphysis and are often accompanied by extensive periostitis.

The roentgen appearance of the osteochondritic process is characteristic and scarcely to be mistaken for any other condition. Rickets often accompanies congenital syphilis but rachitic bone changes are also characteristic, and both diseases may often be diagnosed in the same patient from the roentgen findings.

The earliest change that takes place is simply a widening of the epiphyseal line, and at this stage there is no roentgenographic evidence of value. A little later, however, the irregularity of the extremity of the diaphysis is apparent and from then on it is progressively easy to recognize the nature of the disease.

It should be remembered that periosteal thickening is often an accompaniment of rickets and too much stress must not be placed upon its presence as an evidence of syphilis. The cupping of the diaphyseal extremities in rickets and the irregular dentate appearance in syphilis are distinctive.

[1] Findlay, Leonard. Syphilis in childhood. Oxford Medical Publications. Henry Frowde, and Hodder and Stoughton, London, 1919.

[2] Turnbull, Hubert M. Recognition of congenital syphilitic inflammation of the long bones. *Lancet, Lond.*, 1922, i, 1239–1241.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES

WE contemplate the publication of a list of roentgen society meetings such as that below, in each issue of the Journal, gradually adding other home and foreign societies as the information reaches us. Secretaries of societies not here listed are requested to send the necessary information to the editor.

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Charles L. Martin, Dallas, Texas.
Twenty-Eighth annual meeting, to be announced.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Washington, D.C., 1927.

THE RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Annual meeting, Milwaukee, Wis., Nov. 29–Dec. 3, 1926.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. Sherwood Moore, St. Louis, Mo.
Annual meeting, Atlanta, Georgia, Nov. 15–18, 1926.

THE CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.
Annual Meeting Victoria, B. C., during week of June 21–25, 1926.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. Edward S. Blaine, 5 S. Wabash Ave.
Meets monthly on second Friday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. E. P. McNamee.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. Henry L. Ulbrich, 1130 E. Grand Blvd.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

THE NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Charles W. Blackett, 35 Bay State, Rd., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Eugene V. Powell, 217 East 42d St.
Meets monthly on second Monday, New York Academy of Medicine.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.
Meets in Victoria, B. C., during week of June 21–25, 1926.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. S. C. Davidson, Highland Hospital.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Davis Spangler, Dallas, Texas.

RADIOLOGICAL SECTION AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.
Meets at Dunedin, New Zealand, during February, 1927.

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

THE BRITISH RÖNTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London; W. 1.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prag, 11/52.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Torino, Torino.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medcine, 1 Wimpole St., London, W. 1.

SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Meets in Copenhagen.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY

On May 15, 1926, a meeting was held in Syracuse, N. Y., and the Central New York Roentgen Ray Society was formed. Meetings are to be held three times a year —April, August and November.

The officers for the coming year are as follows: C. F. Potter, Crouse Irving Hospital, Syracuse, president; D. S. Childs, 316 Gurney Building, Syracuse, secretary.

SECTION ON RADIOLOGY

Illinois State Medical Society

At a recent annual meeting of the Illinois State Medical Society, a Section on Radiology was established. Henceforth a radiological program will be held in connection with the meeting of the state society each year.

HONORARY DEGREES FOR ROENTGENOLOGISTS

We are informed that Dr. Arial W. George and Dr. Thomas A. Groover have received honorary degrees from their Alma Maters at the Spring convocations. Dr. George was accorded the degree of Doctor of Science from Tufts College on June 14, and Dr. Groover a similar degree from George Washington University on June 9.

STANDARDIZATION OF ULTRAVIOLET RAYS

To the Editor:

I am writing to you concerning the paper by Ernest A. Pohle, in the American Journal of Roentgenology and Radium Therapy for March, 1926. Although this attempt at clarification of the use of one modality of physiotherapy is welcomed, the real problem for the therapeutist cannot be solved by the gross measure of light, using the term either in its broad sense of electromagnetic energy or in its limited application, infra-red, visible, ultraviolet. Admitting that one has successfully measured the ultraviolet, he has not materially aided his patient, or himself. The application of ultraviolet depends on the knowledge that "ultraviolet" is as broad a term as drug. It would be no addition to therapy to find some measure of drug. One would want to know what drug? So in ultraviolet. By and large, there are three zones of ultraviolet for therapy. These are the near, middle, and far. The physics and physiology of each of these zones are different one from another as the pharmacologic differences of strychnine and morphine. Different bands in the same zone give different reactions. Perhaps a fitting analogy would be that of the raw drug and its alkaloid.

Each source of light and ultraviolet sold to the physician emits different proportions of the zones of ultraviolet. The standard Mazda C lamp, sold under at least fifty names, emits about one-half per cent near ultraviolet as passes through glass. One does not tan sitting under Mazda C lamps, nor does one protect against rickets. Carbon flame lamps, and

mercury arc in quartz deliver ultraviolet qualitatively to and through the far ultraviolet in decidedly different proportions. Impregnated carbon electrodes give different emanation than pure carbon. Further, the mercury arc in quartz emits qualitatively and quantitatively, a different emission characteristic for every ignition, and for every moment of that ignition.

It is not possible to convey the actual extent of the problem of phototherapy, or even of ultraviolet therapy in a letter. It should be part of this one, however, to indicate that no experiment has yet been completed in human therapy utilizing ultraviolet rays alone. Every emanator available gives infra-red, and visible radiation together with varying proportions of the near, middle and far ultraviolet. Although filters can cut off far ultraviolet, and permit the passage of the middle or near, we have not progressed enough to have a filter cut off the near and middle, and allow the passage of the far ultraviolet. The ideal condition will be met when we have facilities for intense enough monochromatic light in the ultraviolet zones to be able to experiment with them.

Hence, every measure of ultraviolet until that time is helpful only if it can indicate what range of ultraviolet is measured. As far as I can glean from the paper under discussion, this is not accomplished by the intricate reaction modified by the author.

If a relative measure of light is wanted, other than the clinical acumen of the physician (who considers as no mechanical measure can on the basis of experience, the influence of blond patient, freckled patient, negro patient, temperature), the Fürstenau actinometer is easy to use, gives a relative dosage in one moment and according to the deviser, 40 "Q" on his scale indicates an erythema dose, providing the mercury arc in quartz lamp has been used. If the scale reading is 5 "Q", for example holding the selenium cell receptor on the level of the part of the patient to be treated at the distance selected, eight minutes is the time for the erythema dose. I am not prepared at this time to give my experience with this instrument. Herman Goodman.

April 16, 1926.

To the Editor:

After due consideration of Dr. Goodman's letter, which you have been kind enough to forward to me, I must state that he objects to claims I have never made. In his criticism he only emphasizes some of the limitations of the described test which are already set forth at length in the article; to go into details would simply mean to abstract here the major part of the paper under discussion.

Regarding the biological effect of ultraviolet rays of different wave length, it seems to me that there is some misunderstanding. Hausser and Vahle (pp. 193–194, Fig. 2, of my paper) have convincingly shown by working with monochromatic ultraviolet radiation on the human skin that the wave length 2970 Å has the maximum biological effect. The remark of Dr. Goodman that such experiments have not been done so far is therefore incorrect. I also cannot follow Dr. Goodman's reasoning of the uselessness of measuring the total output of a mercury vapor lamp. I may refer to the same problem in roentgen therapy where we do measure the total intensity of the spectrum without knowing the biological effect of the various wave lengths. In contrast with this criticism of the photochemical test is Dr. Goodman's recommendation of the Fürstenau actionometer which responds to 2200–6000 A (according to Dorno), an instrument which introduces the so well-known, rather undesirable inconstancy of the selenium cell.

At last, two minor details: I have not modified the reaction for which Dr. Goodman gives me credit; this has been done by Keller (see p. 196). As to the different emission of various types of lights, I feel confident that this fact is well known (see for instance, Coblentz, *American Journal of Electrotherapeutics and Radiology*, Dec., 1925, p. 445). My investigations dealt, as clearly stated, only with mercury vapor lamps (see p. 193) and the use of the test should, of course, be restricted to this type.

E. A. Pohle, M.D.

Ann Arbor, Michigan, May 10, 1926.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

PHYSICAL MEASUREMENTS OF RADIATION AND THEIR APPLICATION TO THERAPY*

BY J. L. WEATHERWAX, A.M.

Physicist, Philadelphia General Hospital and Graduate School of Medicine, University of Pennsylvania

PHILADELPHIA, PENNSYLVANIA

SCIENTISTS have been interested in physical measurements of radiation as applied to radiation therapy for the past few years. Their aim has been to aid the roentgenologist in delivering a definite roentgen-ray intensity of known penetration into a tumor, which can be accomplished with a fair degree of accuracy as follows: (1) Standardization of roentgen-ray installations; (2) the application of depth dosage charts to individual patients, and (3) the use of some method of measuring the output of radiation during treatment.

(1) The standardization of roentgen-ray installation is made for the purpose of knowing the output of radiation. The method in use by us in making these standardization measurements is an electroscopic system attached to a horn ionization chamber[1] as shown in Figure 1. The horn ionization chamber has a capacity of about one cubic centimeter. A water phantom made from aluminum with one-quarter inch of soft rubber vulcanized on the inside is used to represent the patient. The size of the water phantom is made to compare in size to the average patient.

The procedure in making standardization measurements is to employ the same factors in operating a roentgen-ray machine from one installation to another which are as follows: 200 kv., 4 ma., 0.51 mm. of copper and 1.0 mm. of aluminum as filters, and a field 20 cm. in diameter at 50 cm. skin target distance. With the roentgen-ray machine in operation, a measurement representing the output of radiation is first made with the ionization chamber half-submerged in water. The operator stops the roentgen machine and a known quantity of radium is then placed in a fixed position over the electroscope. A reading of the ionization current produced by the radium radiation is obtained. The value of the ionization current for the radium is divided by the number of milligrams of radium, thus giving the ionization current for one milligram of radium. The ionization current representing the roentgen-ray intensity is divided by the ionization current representing one milligram of radium intensity giving the number of milligrams of radium to produce the same intensity as the roentgen rays. From our experience, we know that 500 mg. of radium represents the output of radiation for a good roentgen-ray installation, as measured by our apparatus. If the intensity from a roentgen installation gives an equivalent intensity of less than 500 mg. of radium, we are quite sure that we are not getting the output of radiation we should. We have measured the intensity of roentgen-ray installations giving an equivalent radium intensity of 350 mg.,

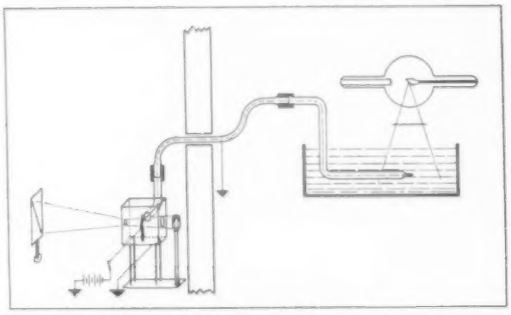

FIG. 1. Electroscopic ionization apparatus for standardization of roentgen-ray installation.

* Read at the April, 1926, meeting of the PHILADELPHIA ROENTGEN RAY SOCIETY.

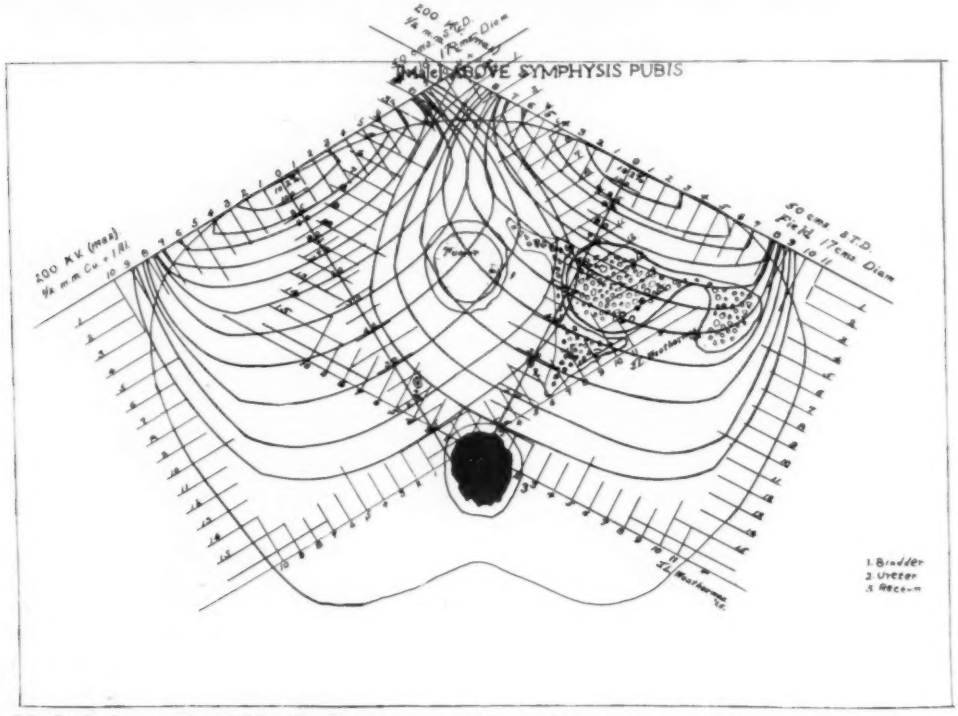

FIG. 2. Method of arranging fields, direction for cross-firing and depth dosage by the use of intensity distribution curves.

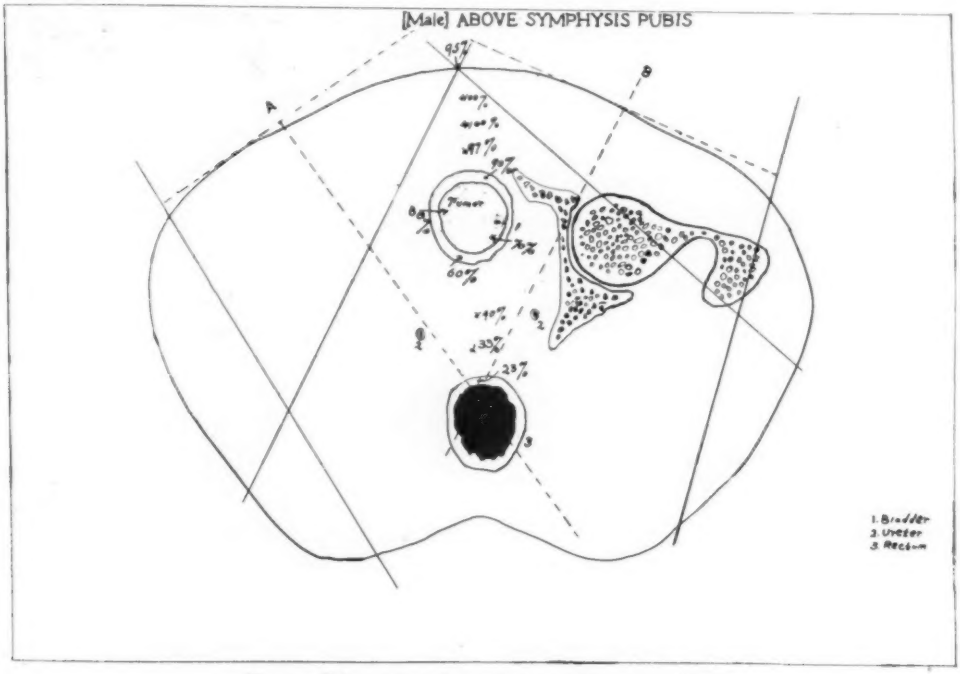

FIG. 3. Diagram to be used in setting up patients.

which means that there is a 30 per cent loss in intensity.

If a roentgen-ray installation gives an output of radiation which has an equivalent radium intensity below 500 mg., it is essential that a careful examination be made of all the parts entering into the operation of the roentgen machine. A low output of radiation does not necessarily mean that the roentgen machine is at fault, but may be due to a leaky insulator, a milliampere meter reading too low, or other factors entering into the adjustments of the roentgen-ray installation. When adjustments and changes in the installation are made, each one should be followed by measurements of the output of radiation so as to determine whether there has been an increase, or a decrease. In practically all installations, the output of radiation can be brought up to the normal constant of an equivalent radium intensity of 500 mg., if the manufacturer and the physicist will work together to eliminate the losses. The physicist has not done his full duty in simply reporting a low intensity, but should try to find and help to eliminate the cause.

If the roentgen installation gives an equivalent radium intensity of 500 milligrams, we can compute the number of milliampere-minutes to give an erythema at one exposure. With the same voltage, milliamperage, filter, field and skin target distance, an erythema of equal intensity will be obtained in the same number of milliampere-minutes by other standardized roentgen installations. Roentgenologists from various parts of the country can compare their erythema intensity when working with standardized roentgen installations.

(2) We should have a knowledge of the average wave length as well as the intensity of roentgen rays. The average wave length delivered by a roentgen-ray installation governs the penetration of the roentgen rays in the tissue. We have measured the penetration in water for roentgen rays of a definite average wave length, so that if penetration measurements of a roentgen-ray installation check our penetration measurements for the same depth in the water and for the same field, we know that we must be dealing with the same average wave length.

Ionization measurements of the roentgen-ray intensity on the surface of the water are made with the ionization chamber half-submerged in water. The ionization chamber is lowered into the water and ionization measurements made of the intensity at various depths. The roentgen-ray intensities at various depths are compared with the roentgen intensity on the surface of the water, and the percentage of roentgen-ray penetration computed. These percentage intensities are then compared with depth dosage charts[2] made on a roentgen installation under similar conditions and giving the same average wave length. If there is a close agreement of the penetration intensities, and there should be with the same average wave length, then the roentgenologist can safely use the depth charts routinely while treating patients. It is obvious that to get depth dosage charts of each roentgen-ray machine standardized, the time for these measurements would run into weeks, so we compare the measurements of a few penetration percentages with those on the charts and assume that there is a close agreement for other points in the field. There are a number of different sets of curves needed to outline the distribution of roentgen-ray intensities in the use of any given installation such as is found in varying the voltage, the size of the field, the filter and the skin target distance. Of course, the roentgenologist will tend towards a

FIG. 4. Ionization chamber before mounting.

comparatively few standard combinations in running his roentgen machine, but these combinations vary from one roentgenologist to another.

The charts showing the penetration of roentgen rays can be used as a guide in the treatment of patients as shown in Figures 2 and 3 and described in detail in a recent publication.[2]

(3) Even though a roentgen-ray installation has been standardized and from time to time re-standardized, there are a great many advantages in having an ionization chamber in a fixed position between the patient and the copper filter so as to have a continuous reading of the output of radiation while treating patients.[3] With an ionization chamber in the field of radiation during treatment of patients, we are measuring the output of radiation as well as measuring the input of electrical energy.

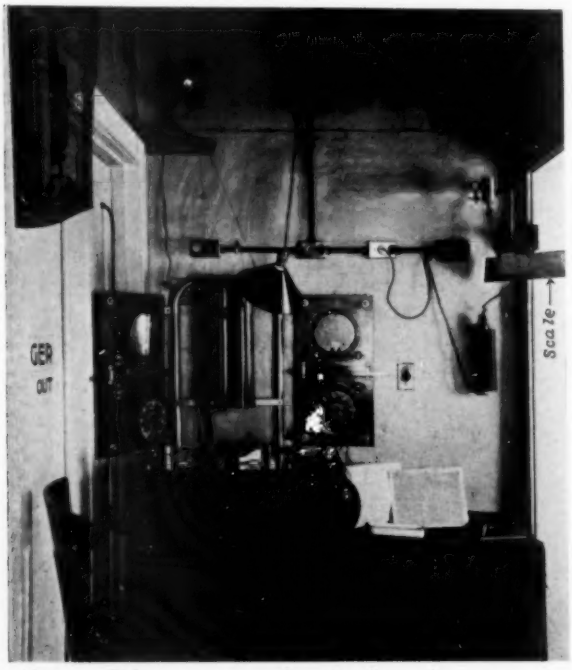

FIG. 5. Galvanometer and scale shown in operator's booth.

The ionization chamber is made of aluminum plates of a total thickness of one millimeter, which takes the place of the usual one millimeter of aluminum filter. Figure 4 shows the ionization chamber before being mounted between the copper filter and the patient. The ionization chamber after being mounted, is connected to a galvanometer and to 300 volts of radio B-batteries. The galvanometer and scale are mounted in the booth with the control stand where the operator can easily observe the readings, as shown in Figure 5.

The operator will have more respect for careful work if he can see the effect caused by fluctuations in voltage and milliamperage on the output of radiation. The omission of a filter will be observed within a few seconds after starting the roentgen machine because of the increased galvanometer reading produced by an increased output of radiation. A more detailed description of this method is found in a previous publication.[3]

So far we have talked only of our own standards. We have not mentioned the fact that our standards are not universal. Our roentgen-ray installations are not measured according to the same standards as roentgen installations elsewhere unless the same apparatus, or apparatus compared to the same roentgen machine, is used in making standardization measurements. Since we have no universal standards in radiation therapy, it seems to me that the time is ripe to persuade the Bureau of Standards of the urgent need of a Department of Radiology. If the Bureau of Standards can be persuaded to embody such a request in their budget, then there is the problem of making Congress see the necessity of an added department which means an increased budget. This might be accomplished by asking each roentgenologist to inform his Congressman of the need of such a department. If I may, I would like to suggest that the Philadelphia Roentgen Ray Society urge the American Roentgen Ray Society to appoint a committee on standardization to cooperate with the Bureau of Standards in getting the needed legislation to establish a Department of Radiology.

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2. Weatherwax, J. L., and Leddy, E. T. A practical method of constantly measuring the radiation from a roentgen tube with a check against the omission of filters. Am. J. Roentgenol. & Rad. Therapy, 1924, xii, 271–279.

3. Weatherwax, J. L., Bradley, Robert A., Bowen, David R., and Leddy, E. T. A convenient and accurate method of measuring roentgen-ray depth dosage. Am. J. Roentgenol. & Rad. Therapy, February, 1926, xv, 169–174.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

BOOK REVIEWS

THE PATHOLOGY OF TUMORS. By E. H. Kettle, M.D., B.S. Lond., Professor of Pathology and Bacteriology, Welsh National School of Medicine, Cardiff; formerly Pathologist and Lecturer on General and Special Pathology, St. Mary's Hospital and Medical School; Pathologist to the Cancer Hospital, Brompton. Second edition. Cloth. Price, $5.00. Pp. 285, with 159 illustrations. New York: Paul B. Hoeber, Inc., 1925.

A brief and concise manual discussing the neoplastic diseases of the human body.

The text consists of 276 pages, divided into part (1) which discusses the general biology of tumors; part (2) the general pathology of tumors, and part (3) the special pathology of tumors. Since the first edition the sections dealing with etiology, experimental research, the carcinomata and the endotheliomata have been brought up to date. The work is well illustrated with 159 very good illustrations.

While, as the author states, the mass of detail proper in a more ambitious work of reference has been omitted the subject matter is however presented in ideal form for the student of pathology.

J. HARPER, M.D.

BOOKS RECEIVED

AN INTRODUCTION TO THE STUDY OF X-RAYS AND RADIUM. By Hector A. Colwell, M. B. (Lond.), D.P.H. (Oxf.), Director of the Radiological Department, King's College Hospital. and Lecturer in Radiology in King's College Hospital Medical School, University of London, and Cecil P. G. Wakeley, F.R.C.S. (Eng.), F.R.S. (Edin.), Assistant Surgeon, King's College Hospital; Lecturer in Anatomy, King's College, University of London. Cloth. Pp. 203, with 37 illustrations. Oxford University Press, 1926.

DIATHERMY, WITH SPECIAL REFERENCE TO PNEUMONIA. By Harry Eaton Stewart, M.D., Consultant in Physiotherapy, U.S.V.B. Hospital, New Haven, Conn.; Director, New Haven School of Physiotherapy. Second edition. Cloth. Price, $3.00. Pp. 228, with 45 illustrations. New York: Paul B. Hoeber, Inc., 1926.

COLLECTED PAPERS BY THE STAFF OF THE HENRY FORD HOSPITAL. Cloth. Price, $8.00. Pp. 634, with 151 illustrations and 42 charts. New York: Paul B. Hoeber, Inc., 1926.

MODERN VIEWS ON DIGESTION AND GASTRIC DISEASE. By Hugh MacLean, M.D., D.SC., M.R.C.P. Professor of Medicine, University of London, and Director of the Medical Clinic, St. Thomas's Hospital; Honorary Consulting Physician to the Ministry of Pensions; Consulting Chemical Pathologist to St. Thomas's Hospital. Cloth. Price, $4.00. Pp. 170, with 14 charts and 23 figures. New York: Paul B. Hoeber, Inc., 1926.

THE PRINCIPLES OF ANATOMIC ILLUSTRATION BEFORE VESALIUS. By Fielding H. Garrison. A.B., M.D. Cloth, Price, $2.50. Pp. 58, with illustrations. New York: Paul B. Hoeber, Inc., 1926.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL (*76 Fifth Avenue, New York*) *their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

OSTEOCHONDRITIS DEFORMANS JUVENILIS COXAE

(Legg-Calvé-Perthes' Disease)

BAUMGARTNER, J., and MOPPERT, G. G. Deforming juvenile osteochondritis of the hip and tuberculosis of great trochanter. *Schweizer. med. Wchnschr.*, 1924, liv, 792–793.

Since the original descriptions given by Legg, Calvé, and Perthes the conception of osteochondritis deformans juvenilis has undergone considerable evolution. It was in the beginning considered a pathological entity because of the roentgenological features, but it has more and more come to be regarded as a syndrome caused by many factors (trauma or infection, for instance) in an exposed region during the period of growth. The view which appears to be essential at the present time is that one should not invoke a single etiological cause for the three diseases, osteochondritis, coxa vara, arthritis deformans juvenilis. A variety of causes may produce a disturbance in the growth phenomena of the upper end of the femur. This conception was brought out very particularly in the discussion at the Fourth Annual Reunion of the French Society of Orthopedists in Paris, in 1922.

An illustrative case is presented in a girl aged five, who commenced to limp during convalescence from measles. By means of a single puncture of the hip joint pus in the cavity was removed and iodoform injected. The hip was immobilized in a cast for six months and the child was then discharged as cured. She returned at the age of eleven with a complaint of slight lameness and pain localized in the right buttock. Her condition was diagnosed as osteochondritis deformans of the hip. In the roentgenogram there was absence of any articular reaction, and there was freedom of motion except abduction, which was limited. The tuberculin reaction was very positive and the Wassermann negative. The child was treated by immobilization for several weeks.

The girl re-appeared at the age of sixteen with a cold abscess at the antero-external surface of the thigh. The roentgenogram showed at this time a flattening of the head and a decrease of the angle of inclination of the neck and the presence of a local area of osteitis in the great trochanter. The tuberculous nature of the affection was confirmed by the examination of the pus of the abscess. This abscess was cured in three months, and subsequently the girl took a course of heliotherapy during the Summer and Fall. However, the region of the trochanter again began to show swelling and pain, and operation was decided upon to open up the tuberculous area. The external half of the great trochanter was extirpated, and recovery was normal. The roentgenogram at the present time shows the development on the one hand of an osteochondritis deformans of the hip which appears to be typical, and on the other hand, the existence of an area of osteitis of the great trochanter, the development of which has indicated its tuberculous nature. This last lesion appears particularly on later roentgenograms while the osteochondritis appears cured, although it is probable that it might have been present in the earlier roentgenograms but was missed.

It would seem that the zones of rarefaction of the head of the femur and of the acetabulum were both of tuberculous nature, but it would appear more logical to attribute them to a trophic disturbance since the articulation remained unaffected throughout the development of the disease.

BLENCKE, HANS. A case of osteochondritis deformans juvenilis of the knee and hip joint; Perthes' disease. *Zentralbl. f. Chir.*, 1924, li, 344–345.

A brief description is given of a case occurring in a boy aged seven having symptoms suggestive of tuberculosis of the right knee. There was pain at the internal condyles of the tibia and femur and of the patella. The circumference of the knee was increased about one centimeter. There was no fluid and no noteworthy interference with movement.

The roentgen examination disclosed strikingly broad epiphyseal zones of all the bones of the knee. There was no atrophy or other sign to support the suspicion of tuberculosis. The patella showed a typical picture of osteochondritis deformans. It had in the upper two-thirds a sickle-shaped sclerotic area while the rest of the tissue surrounding this dense focus was very flaky with an atrophic appearance at the lower pole of the patella, where in addition there was a distinct separation into fibers and a small island of ossification separated from the upper portion of the patella by a narrow space. In addition the lateral edges of the epiphyses of the femur and tibia were very jagged and broken into fibers with the normal sharp boundary completely absent.

There were no other objective changes in the extremities. The conclusion was reached that tuberculosis of the knee could be excluded and that the picture was one of osteochondritis of the epiphyses at the knee. The further progress of the case confirmed this diagnosis. The knee healed spontaneously under care and required no special treatment.

The child came under examination again five months later because of limping. The examination disclosed the typical picture of osteochondritis deformans coxae juvenilis (Perthes) of the right hip, while the knee joint previously under observation was now completely recovered. The earlier examination showed nothing unusual at the hip and it is therefore assumed that the Perthes' disease developed subsequently.

It is suggested that the origin of the disease is in some way associated with a constitutional factor. This is deduced from the broadened out appearance of the epiphyseal junctions. A history of trauma in this case was indistinct or absent.

Boyd, W. A. Osteo-chrondritis deformans juvenilis. A review—report of cases. *J. S. Carolina M. Ass.*, 1923, xix, 669–676.

While the exact etiology of this condition is still unknown, it seems quite clear that it is not hereditary, although cases have been reported occurring in more than one member of a family. The disease shows a definite predilection for the second half of the first decade of life, affecting boys more frequently than girls. It may be in existence long before clinical manifestations appear.

The true pathology of the disease must await determination until definite post mortem studies are available or more cases in the early stages are operated upon, with subsequent laboratory study of the material removed.

In the roentgenogram the bone shows a thinning out of the calcium salts in the epiphysis giving the latter a laminated appearance. There is softening or total destruction of areas in the bone substance of the head, flattening out of the epiphysis, thickening and shortening of the neck, and deformity of the head of the femur. All the cases, treated or untreated, get well with always, however, some deformity of the joint. The roentgen-ray appearances will eventually determine the diagnosis. Other conditions that might be mistaken for osteochrondritis are osteomyelitis of the hip, juvenile deforming arthritis of the hip, and coxa vara. A careful clinical study and investigation together with the roentgenographic findings should easily determine the diagnosis. The sole object of treatment must be the lessening of destruction and of flattening out of the head of the femur.

Reports are given of 3 cases, 2 boys aged fifteen and three and a half, and a girl six and a half years. In each of these the diagnosis was Perthes' disease.

Büttner, Georg. Perthes' disease. *Med. Klinik.* May 8, 1925, xxi, 685.

The relatively mild symptoms distinguish Perthes' disease from tuberculous coxitis. Measurements of the spina-malleolus distance show a shortening of 1 to 2 cm., and in advanced cases up to 4 cm., with normal distance between trochanter and malleolus; the trochanter major extends above the Roser-Nélaton line; symptoms which suggest coxa vara, and also impacted fracture of the neck of the femur. The roentgenogram explains the nature of the disease process which takes place not in the neck of the femur but in the epiphysis. The head of the femur is mushroomed out, often indented or shoved down against the neck of the femur. In advanced cases the head-cap may become very much narrowed and the medial angle of the epiphysis is in these cases often least reduced in size. In the mild cases deformation is often hardly recognizable. In one case with bilateral involvement the slight flattening could be recognized only after comparison with a normal picture. The epiphyseal line is not sharp, appears broadened and often filled with flaky shadows, while the joint cartilage line remains intact, as a rule. In certain cases secondary changes are found in the acetabulum together with bending of the neck of the femur.

The essential point for the practitioner to remember is that mild hip pains should not be ignored and passed off as mere growth disturbances.

Perthes' disease is regarded as related to that group of epiphyseal necroses observed by Köhler, Schlatter, Kienböck, Preiser, Friedrich, and others. Exogenous causes are trauma, infections (mild osteomyelitis), emboli. The endogenous causes (age, disposition) are found in hereditary factors and endocrine disturbances. These diseases are related to: (1) arthritis deformans; (2) late rachitis; (3) coxa vara, valga and plana; (4) epiphyseal break-down, Perthes' fracture of the neck of the femur. These various aspects and their interrelationships are briefly discussed.

The occurrence of otitis media and of angina in conjunction with Perthes' hip disease has been observed by the author and is regarded as significant of the etiology of the hip condition. Of 7 cases of Perthes' disease observed by the author, 4 suffered from hypertrophic tonsils. Some of the cases are cited. This coincidence is

extraordinarily striking and should be followed further.

The aim of treatment should be the prevention of further infractions and to allow the organism time for a resorption of destroyed bone and for regeneration.

CALOT, F. Osteochronditis as congenital malformation. *Arch. de med. d. enf.*, 1923, xxvi, 150–160.

The clinical history of published cases of this condition are: arthralgia, with limping and pain; factors which are congenital are responsible for the conditions described, even physiologic factors, traumatism and pathologic factors. Some cases seem to be caused by one or another of these possibilities. There are two characteristics which point to congenital malformation, namely, the frequent bilaterality of the roentgenologic lesions and negative bacteriologic and histologic findings. The bilaterality is an argument against the disease being caused by traumatism; the negative bacteriologic findings are against any theory involving infection. The author claims to prove the congenital nature of the disease by roentgenologic finding also. Comparing roentgenograms of diseased hips with roentgenograms of normal ones shows very clearly that the abnormal condition is congenital. Illustrations are given in proof. Sorrel, Calvé, and Waldenstrom claim that it is an acquired condition, but the author thinks that if they had compared pictures of normal and abnormal at the same time, they would have thought differently. You must have a thorough knowledge of the normal in order to know the abnormal; this principle applies also in this matter. The author then describes the normal and the abnormal in an effort to prove his contention.

The author shows that in the cases known the hip has never been normal, either roentgenologically or clinically. The development of the symptoms is a natural consequence, and not indicative of the effect following cause immediately after the cause has brought on changes in the hip. Osteochronditis is, then, unrecognized congenital malformations of the hip joint.

CARRUTHERS, F. WALTER. So-called Perthes' disease. *Southern M. J.* 1923, xvi, 954–956.

Perthes' disease is the name applied to a class of cases formerly mistaken for mild forms of "hip disease." The roentgen findings are most important and both hips should be subjected to the examination. With all signs pointing to tuberculosis there is no hazy or cloudy appearance in the joint. The epiphysis looks crushed and flattened with marked eburnation of bone beneath the cartilage. The condition is confined entirely to the head of the femur, and the acetabular surface is never involved. In a well defined case there is a very pronounced change in the roentgen-ray appearance of the bone, while the disability is astonishingly small.

The clinical picture is one of a child usually between the ages of six and eight or older who comes with a history of a fall four to six months previously. There is complaint of one leg which tires easily and there is a slight deformity of the hip. The child is unable to bring the leg inward without some pain which, especially on marked abduction, is severe. Flexion and extension are apparently normal, and possibly there is some shortening of the limb. Bryant's triangle will show no doubt a shortened base line. The condition is unilateral.

Perthes' disease must be differentiated from rickets, syphilis, scurvy, tuberculosis and acute epiphysitis. In rickets the roentgenogram shows involvement of many joints, periarticular swelling and marked disturbance of the epiphyseal line which has an inverted, saucer-like appearance. The epiphysis proper is not disturbed but the epiphyseal line shows change. There is also extreme atrophy and marked periostitis.

In syphilis, there is marked involvement, periarticular swelling and fluid at times. The cartilagenous surface is intact and the epiphyseal line is much disturbed as in rickets. However, there is no softening or saucer-like depression. There is a localized area of softening beneath the periosteum where the cartilage of the joint begins. It looks as if it might have been bitten out, starting at the epiphyseal line and extending into the bone proper. The epiphyseal line is undisturbed, atrophy is generally absent but bone production is seen with periostitis always present.

In scurvy the joint is intact and the epiphysis and epiphyseal line are undisturbed. There is a formation of a destructive line about one-sixteenth inch below the epiphyseal line. Periostitis is always present and at times a hemorrhagic area will be seen which might be mistaken for sarcoma when the stage of severe pain is past.

Tuberculosis is usually seen about the third or fourth year of life, and sometimes later, but as a rule only one joint is involved, with very marked periarticular swelling, which makes the joint very indistinct in the roentgenogram in the early stages. As the disease progresses the articular surfaces become irregular and worm-eaten and the cartilage and surrounding bone are slowly destroyed with marked atrophy. Acute epiphysitis is almost impossible

to differentiate from tuberculosis except that as a rule the joint does not become so hazy and the destruction is more rapid. As the disease subsides there is bony ankylosis, while in tuberculosis, as a rule, there is cartilage.

DAVID, S. D. Legg's disease—with a report of a case in adult. *Texas State J. M., Fort Worth*, 1924–25, xx, 325–327.

The case reported occurred in a man, aged thirty-five, who had had rheumatism in the right hip when twenty years old. The patient had a dull aching pain in the left hip but there was no swelling, and he did not limp. There was no pain on motion and no muscular atrophy. The Trendelenburg sign was absent. The great trochanters on both sides were above the Roser-Nélaton line. Both hips showed limitation in abduction and in internal rotation, but no shortening. Although the patient complained of the left hip only, both hips were alike involved.

The roentgenograms showed both hips deformed. The head of the femur was of the mushroom type. The neck was very short and slightly hypertrophied, with the axis almost normal. The acetabulum was very thick and shallow. The right hip showed a remnant of the femoral head in the form of a cone-like structure lying in a very shallow but thick acetabulum. There were several rarefied areas simulating cysts or vacuoles. The great trochanter was not distinct.

DE RAFFELE. Juvenile arthritis deformans. *Chir. d. org. di movimento*, 1923, vii, 65–103.

A boy of fourteen began to have pain in the dorsum of the right foot about four years ago, particularly in the mediotarsal region. The pain was usually slight but sometimes there were attacks that obliged him to rest for some days and left the movements of the foot limited and painful for a week or two. These attacks of subacute inflammation were accompanied by pain and redness of the region but never by fever. But in time the movements of the foot became permanently limited; he limped, it was painful to stand long on the right foot and he threw all the weight of the body on the left leg. The foot assumed a slight valgus position, the arch flattened somewhat and the leg atrophied. The disease remained limited to this foot. He was given physical treatment (thermotherapy, massage, mobilization, etc.) and discharged with the foot fixed in a cast in a slight varus position. He recovered under this treatment and remained well for three years when he returned in the same condition as before. An incision was made over the astragalo-scaphoid joint. The astragalus was deformed by a ridge along the anterosuperior edge of its head and by a hemispherical protuberance in the center of its anterior surface which indented the posterior surface of the scaphoid slightly. The joint surfaces had lost their physiological sheen and were covered by an opaque layer. There was a small quantity of serous fluid in the joint cavity. An osteo-cartilaginous flap was resected from both the joint surfaces and a small wedge, taken from the scaphoid, was implanted near the external end of the joint line between the astragalus and scaphoid so as to fix the foot in a slight varus position. He was dismissed with a plaster cast which was left on a little over two months; when it was removed the foot was in excellent position; active movements a little limited, passive ones free and painless.

A girl of eleven had begun, when about a year old, to have swelling of the right foot and the movements of the joint between the tibia and astragalus became limited and painful. These symptoms increased in intensity but there was never any inflammation or signs of involvement of other joints. No history of hereditary diseases. Right leg markedly hypotrophic. Foot in slight equinus position, active movement of the joint possible for only a few degrees. Hard protuberances could be felt along the joint fissure which seemed to form a part of the bone. No crepitus. Reflexes normal. No disturbances of sensation. Wassermann and tuberculin reactions negative. Curved incision around the outer margin of the external malleolus, plastic elongation of the tendons of the peroneus muscle, astragalectomy. The joint surfaces of the tibia and astragalus were nodular, the cartilage had lost its sheen and looked fibrous. The anatomical picture was that of arthritis deformans. Reconstruction of the peroneus tendons, suture of the skin, plaster cast. Uneventful recovery.

Both cases had pain, functional disturbance, chronic course and only one joint was affected. The attacks of inflammation in the first case were probably an attempt at a general reaction on the part of the organism. The early stages of the disease can only be shown by roentgen examination. Roentgenograms of these two cases are given. The form of one or more of the components of the joint is changed, the degree of change depending on the stage of the disease. The bones may not only be changed in form but increased or decreased in size. There may be marginal ridges of new-formed bone around the head of the joint giving it a fungiform appearance. Toward the center of the joint surface there may be rounded protuberances of new-formed bone which tend to indent the opposite surface. In addition to the marginal ridges there may be osteophytes in the form of

spurs or hooks or small rounded or flattened blocks of bone connected with the bone surface by pedicles. The line of ossification between bone and cartilage, instead of being straight, as it normally is, is wavy or slightly jagged. Zones of rarefaction and condensation may be seen in the joint head, a differential sign from other bone diseases in which the signs of atrophy or condensation are uniformly diffuse. Histological examination shows that the process probably begins in the center of the joint cartilage. The superficial layers of cartilage cells gradually break down and become necrotic and the process extends deeper until it disturbs the connection between cartilage and bone.

The cause of the disease is still unknown. Poncet and others believe it is tuberculous, but histological examination has not shown characteristic tuberculous lesions and in the author's cases there were no clinical signs of tuberculosis and the intradermal tuberculin reaction was negative. It has been attributed by some authors to disturbances of internal secretion but no definite evidence of such etiology has been brought forth. It has also been attributed to intoxication following visceroptosis, to lesions of the central or peripheral nervous system, congenital affections of the nervous system, primary necrosis of cartilage due to trauma, specific bacteria and disturbances of circulation, but none of these theories has been definitely proved. The author believes there is a congenital factor in it, in view of the early age at which his cases developed and the lack of any other cause to explain it.

Physical treatment may be tried in the early stages, and in addition to hyperemia, massage and movement an extract of animal cartilage and a solution of human fat obtained on operation have been used but their effects seem to be rather uncertain. Needless to say rest is indicated in the acute stage. In the more advanced cases arthrotomy or resection is indicated. The latter is generally to be preferred as it removes the pathological tissue, improves the nutrition of the muscles and suppresses the pain and other local symptoms. In the author's second case astragalectomy seemed definitely indicated. The astragalus is not, as is generally supposed, the keystone of the arch of the foot; its removal does not necessarily bring about a flattening of the arch which, on the contrary, is rather accentuated. Ordinarily as Ollier has shown the movements of the foot reacquire two-thirds of their normal amplitude, flexion is almost equal to extension and both are sufficient to enable the patient to walk 15 or 20 kilometers without pain. The good functional and anatomical results after astragalectomy have long been known and the failures (equinism, varus, flexion of the great toe) are not due to the operation itself but to insufficient after-treatment.

Egaña, Alberto Rodriguez. Infantile deforming osteochondritis. Legg-Calvé's disease. *Semana med., Buenos Aires,* Sept. 3, 1925, xxxii, 549–566.

Ten cases of this disease are described with roentgenograms. It cannot be diagnosed from the clinical symptoms alone. The pain in the diseased joint is not characteristic nor is the claudication different from that of other diseases. One characteristic point is the disproportion between the pain and the rigidity of the joint on passive movement; the pain is much less than would be expected from the rigidity. The roentgenogram is the only certain method of diagnosis. The first manifestation of the lesion is the formation of islands of rarefaction in the center of ossification of the head of the femur. The roentgenogram shows distinct zones of opacity and transparency. A few months later there is beginning fragmentation of the center of ossification. It may be divided into a large number of small fragments. When these ossify it leads to the third stage of flattening of the head, or coxa plana. It is flattened in the vertical diameter. The last stage is lamination of the center and it may be reduced to one thin lamina which is hardly visible on the plate. Generally at this stage there is such a deformity of the head that it is hard to differentiate the disease from other conditions.

The primary feature in the pathogenesis of the disease is infection; trauma is secondary. It is never caused by tuberculosis. It may be caused by syphilis, in which case specific treatment should be given. The congenital origin of the disease is very questionable; its supposed etiological relationship with congenital dislocation of the hip is a mistake. It is distinct from deforming juvenile osteoarthritis both clinically and as to pathological anatomy.

Both the immediate and late prognosis is good. The author has never seen any serious injury of the mechanics of the joint or interference with walking. The treatment is immobilization in plaster for the period of pain and contracture. Heliotherapy has been used without any other result than gain in weight and improvement in the general condition.

Galvin, A. H. Osteochondritis deformans juvenalis. *Surg., Gynec., & Obst.,* January, 1924, xxxviii, 58–66.

Brief reports and roentgenograms are presented of 3 cases occurring in 2 boys, aged nine

and fifteen years, and one girl, aged five and a half years. These three patients gave definite histories of trauma. The first boy had a negative roentgenogram at the time of his first trauma, and the typical deformity of osteochondritis deformans juvenilis appeared two years later. This particular observation would appear to rule out the theory of congenital malformation as an etiological agent in this disease.

Children from three to ten years of age, who have painless limp, should have roentgenographic examinations performed. Osteochondritis deformans juvenilis should not be confused with tuberculous coxitis.

Treatment should be by relief from weight-bearing and by application of a plaster spica. Operation is indicated in but a small percentage of cases. The end results, under proper treatment, are invariably good.

GAUGELE, KARL. Perthes' disease. *Zentralbl. f. Chir.*, 1923, l, 1665–1666.

The disease picture during the first stage of Perthes' disease is not always definitely distinguished from tuberculous coxitis. This differentiation becomes possible only when the typical zones of rarefaction and density appear in the roentgenograms of the head of the femur. These characteristic signs, however, sometimes do not appear for several months.

The anatomical end results vary. There are some cases that recover without any appreciable deformity. More frequently, however, the deformity in the end stage assumes the spherical or cylindrical shape of the head of the femur as described by Perthes. The author has, however, practically never personally seen the cylindrical type and believes that this may be avoided by suitable treatment. The cylindrical or mushroom type is believed to be due to strain due to the imposition of the weight of the body upon the head of the bone.

The author has treated cases of Perthes' disease very carefully along the same lines as tuberculous coxitis, i.e., by complete relief from weight-bearing.

HARTLEY, J. N. J. Osteochondritis deformans juvenilis, Schlatter's disease, and other allied conditions. *Edinb. M. J.*, 1923, xxx, 254–259.

"Until recently osteochronditis deformans juvenilis, Schlatter's disease and Köhler's disease were each regarded as unique pathological conditions. There is a growing conviction, however, that these three clinical entities are closely related and may indeed have the same pathogenesis. Moreover the group has been augmented by the discovery of similar lesions in the epiphyses of the olecranon and the calcaneus."

Legg's first description of the disease in 1909. No evidence that the disease is tuberculous or syphilitic. Traumatic theory based on slender evidence. Four cases referred to by Platt in which portions of affected tissue were removed. Legg obtained a staphylococcus and Kidner a *Staphylococcus aureus* from debris curetted from a number of cases. It has received many names, among them being Legg's disease, Perthes' disease, and pseudo-coxalgia.

A recent paper by H. Platt records 18 cases, and 5 cases showing the end results in adults. Boys are more commonly affected and usually between the ages of five and nine. The clinical aspects are described by Platt under (1) stage of onset; (2) active stage, and (3) stage of recovery. The onset may be insidious, with a limp and definite localized pain; in a few cases there was mild pyrexia. The active stage persists for six to eighteen months. The limp and pain gradually disappear, mobility is limited only in abduction and internal rotation. In the stage of recovery the limitation of full abduction is usually the only symptom. The roentgenographic appearance of the femoral head is characteristic. At first the nucleus of the head flattens, becomes fragmented, and the nuclei show by hypercalcification and loss of normal trabeculation. There is no blurring as in tuberculosis. In the final stage the head remains flattened and the upper part of the neck is broadened. Any change in the acetabulum is probably secondary in the way of adaptation to the distorted femoral head.

With regard to etiology, Platt believes the traumatic theory is based on a very slender foundation and that syphilis, tuberculosis and rickets can be excluded. He refers to several cases which were operated upon and tissue removed from the femoral epiphysis. Legg obtained a staphylococcus and Kidner a *Staphylococcus aureus* from cultures from the debris removed. Phemister obtained no growth but the histological structure was that of an old infectious lesion, probably of pyogenic origin. In two cases operated upon by Vignard the appearance of the tissue suggested an inflammatory origin.

Platt concludes that the disease is an inflammatory lesion, the infective agent being of attenuated virulence.

Schlatter's Disease. A partial separation of the epiphysis of the tibial tubercle was described by Osgood in 1903 and by Schlatter in 1908. Trauma was at first thought to be the cause and there is undoubtedly a traumatic separation of the epiphysis occurring usually from sixteen to eighteen years of age. The real Osgood-Schlatter's disease, however, is insidious in onset, often with localized pain and redness. Boys of

fourteen or fifteen years are the most commonly affected. The roentgenographic appearance is characteristic. The bone nucleus in the epiphyseal lip is altered in texture, irregular in contour or fragmented. Eventually the bone fragments fuse and all traces of the lesion disappear.

Köhler's Disease. This lesion is twice as common in males as in females and usually occurs between the ages of five and nine. The onset may be insidious with pain in foot, a limp, tenderness upon pressure over the scaphoid, and swelling of the inner border of the foot. The roentgenographic appearance is again characteristic. The bone nucleus of the scaphoid is thinned and broadened, very dense and devoid of cancellated structure. In some cases there appears to be fragmentation.

The writer also recounts reports of cases of changes in the epiphysis of the os calcis and of the olecranon accompanied by pain and definite roentgenographic findings. He concludes that all of the conditions named have many features in common and possibly the same etiological factor. The structural changes shown in roentgenograms are strikingly similar in all of these conditions. "It is interesting to note that each lesion is associated with a definite age period, and that in each the age period is that in which the affected bone nucleus normally is actively developing."

"As to etiology of these various lesions, it may be as Sundt maintains that there are many factors and that trauma is important as a localising factor. There is little evidence to support his hypothesis of a derangement of the endocrine glands. The prime cause is still obscure. Syphilis, tubercle, and rickets can almost certainly be excluded. Zaaijer favours Lenormant's suggestion that there is a developmental error which manifests itself at the stage of active bone growth . . .

"Calvé, who formerly supported the traumatic theory of Perthes' disease, now thinks that an infective origin is more compatible with the clinical and radiographic observations. This latter theory is certainly now the one most in favour. Final decision, however, must be withheld until further opportunities present themselves of studying the histology and bacteriology of the affected tissues."

HENSON, E. BENNETTE. Fracture of femur by indirect violence four years after treatment for juvenile deforming osteochondritis. *West Virg. M. J.*, 1924, xix, 471–473.

A boy 9 years old received a comminuted fracture of the left femur at the juncture of the upper and middle thirds. Upon examination of the roentgen plate which included both hip joints there was found to be quite a difference in the outlines of the heads of the two bones. The picture was typical of Legg-Perthes' disease.

The boy's history disclosed the fact that he had been treated and cured of the hip condition four years previously.

The roentgenograms taken immediately after the fracture showed an unusual condition present. On the outer surface of the femur there was a a large fragment of bone resembling a chip of wood from the lumberman's ax. The appearance was that of a brittle bone. There was no evidence of infection or tumor. The fact that this boy received a fracture of the femur by indirect violence four years after being cured of a disease the etiology of which is not definitely known should justify a longer and closer observation of these cases.

KEHL. A critical review on Perthes' disease (osteochondritis deformans juvenilis coxae). *Deutsche med. Wchnschr.*, Jan. 23, 1925, li, 169–170.

Since Perthes in 1910 and 1913 described the clinical picture of this disease, no essentially new facts have been added to the diagnosis and therapy. In a number of cases trauma is given as the initiating factor. The roentgen picture is of major importance in establishing the diagnosis. In the very early stages, the roentgenogram may show no changes whatever, excepting that the bone on the diseased side is somewhat smaller. In the interior of the head along the epiphyseal plane and also usually on the external side there are isolated rarefactions due to circumscribed disappearance of bone. Similar changes follow in adjacent portions of the neck, and with enlargement of confluent foci the epiphyseal line is broken and the head, during the peak of the illness, appears like a ruined, dissolved out structure, somewhat flattened and compressed. Serial roentgenograms then show how the neck of the femur gradually becomes thicker and shortened. The flattened and compressed head merges with the neck to a single mass and its edge then approaches the trochanter. The acetabulum accommodates itself by a flattening out. The space between the bone shadows corresponding to the acetabular cartilage and joint space usually appears strikingly broad.

Three methods of treatment for the disease have been suggested: (1) spontaneous recovery; (2) orthopedic measures for supporting the joint, and (3) prompt resection.

Explanation of the etiology on the basis of trauma alone is not conclusive. Certain cases have shown a hereditary tendency. There are numerous suggestions that some developmental anomaly may be responsible.

KEY J. ALBERT. The non-tuberculous hip of early life. II. In childhood. *J. Missouri State M. Ass.*, November, 1925, xii, 429–434.

In childhood, that is from the third to the thirteenth year, not only is the anatomy of the hip changing but it is subject to weight-bearing and frequent trauma. The non-tuberculous hip affections of children that are considered by the author are coxa vara, coxa plana, arthritis and pseudoarthritis.

Anatomically, coxa vara may be due to a slipping downwards of the head of the femur, a deformity of the head or acetabulum, a bending of the neck or an outward bowing of the upper portion of the shaft of the femur. In childhood the important types are rachitic and traumatic, the deformity being in the neck of the femur in both types. Rachitic coxa vara is due to the gradual bending downward of the softened neck under the influence of weight-bearing and muscular pull. The child walks with a waddling gait resembling that of a double congenital hip. The deformity is much less commonly noted than are bow legs or knock knees. It is probable that it is present to a mild degree in most cases of severe rickets. The prognosis is good as many of these cases tend to correct themselves as growth proceeds.

In children the point of least resistance in the hip is the neck of the femur and this is occasionally fractured. These fractures differ from those of adults in that the fracture is usually incomplete or subperiosteal, and there may be little or no deformity or shortening at the time of injury. The true condition is often undiagnosed, and weight-bearing is permitted. The result is a gradual yielding of the femoral neck with a development of marked coxa vara deformity.

Coxa plana or flat hip is the name given to the condition described by Legg as osteochondral trophopathy of the hip, or Perthes' disease, or osteochondritis deformans. It closely resembles tuberculosis of the hip and probably accounts for most of the cases of tuberculosis of the hip which have been cured without deformity or marked impairment of function. In symptomatology this disease resembles a mild case of tuberculosis of the hip. About 10 per cent of the cases are bilateral. The roentgenogram is presumably normal in the beginning. As a rule, however, the roentgenogram shows the head of the femur flattened and the convex border slightly irregular. The epiphyseal line is irregular and the bone structure of both the head and neck are of irregular density. As the disease progresses the head becomes more and more flattened and broadened. The spottiness of the bone structure increases and the head may appear to be fragmented into several pieces or may almost fail to cast a shadow. The epiphyseal line becomes more crooked and the neck is thickened and appears to be shortened. The lateral border of the head approaches the great trochanter. This stage lasts three or four years and then repair begins, calcium salts are laid down and the head and neck become of normal density, though they never regain their normal form. The acetabulum adapts itself to the flattened head. The roentgenographic changes are the only signs whereby coxa plana can be differentiated from mild tuberculosis of the hip. The prognosis is a very serviceable, painless hip with slight limitation of abduction and internal rotation.

The acute cases of arthritis can be divided into the acute rheumatic fever, acute synovitis and acute pyogenic joints. The acute exanthems of childhood are occasionally accompanied or followed by joint complications. This is particularly true of scarlet fever where an acute synovitis either during the disease or during convalescence is a common occurrence. Post-scarlatinal hips usually clear up but in some of the more severe instances the hip may quiet down and permit painless weight-bearing but the joint may be stiff and in a position of deformity. Acute pyogenic hips occasionally follow pneumonia with the pneumococcus as the offending organism. These acute pyogenic hips are usually dangerous to life and must be drained at once. If the patient survives the hip is usually ankylosed in abduction and external rotation.

In childhood there occurs a chronic progressive deforming arthritis which is characterized by atrophy of muscles and joints and contractures of the involved joints. The disease begins insidiously with little or no constitutional symptoms. The large joints are usually favored and the knees and hips are involved early. The swelling is almost entirely periarticular, there being very little fluid in the joints. The roentgenogram shows only bone atrophy and periarticular thickening until very late in the disease when there may be erosion of cartilage or even bony ankylosis. The disease pursues a chronic and relatively painless course and its etiology is unknown. The prognosis is grave. The arthritis may cease spontaneously, but it tends to progress with periods of remission alternating with exacerbations until the child is hopelessly crippled.

Closely allied to this atrophic type is a form of chronic joint disease in children as described by Still. The picture is essentially that just described but there is also an enlargement of

the lymph glands and spleen which is said to be characteristic.

Just as we have chronic hypertrophic arthritis of the hip (mollum coxae senilis) in adults so do we have a chronic arthritis of the hip in children in which no other joint is involved. It is known as arthritis seche by the French and as arthritis deformans juvenilis by the Germans. The onset is insidious, without fever or acute symptoms. The roentgenogram shows erosion of the head or of the acetabulum, or of both, with a certain amount of bony overgrowth around the articular margin. In some cases the roof of the acetabulum is eroded and subluxation occurs. In others the floor is deepened and new bone is laid down inside the pelvis to prevent perforation. The etiology is unknown and the treatment is largely symptomatic.

A progressive coxitis in a child should be considered tuberculous and treated as such until it recovers or is proven to be non-tuberculous. On the other hand, one should not make a definite diagnosis of tuberculosis of the hip in a child without first excluding the hip conditions described above.

Liescheid, Alfred, and Sellheim, Hugo. Osteochondritis, an endocrine disturbance. *Deutsche Ztschr. f. Chir.*, 1924, clxxxv, 46–70.

This is a discussion of the simultaneous occurrence of multiple osteochondritis juvenilis with the typical findings characteristic of early castration in the body and genital apparatus of the female castratoid. A description is given of a case occurring in a girl, aged twenty-one, who began to limp two years previously and complained of pain in the left hip and knee. These symptoms disappeared after rest. Similar symptoms occurred in the right hip three months later. There were no signs of rickets, and the von Pirquet and Wassermann reactions were negative. The extremities were abnormally long, the trunk was short and had a decided lumbar lordosis. Roentgenographically the skeletal system showed a certain calcium impoverishment, causing the bone structure to appear with greater distinctness. Most of the epiphyseal symphyses were well built. At the lower end of the radius and ulna there was a distinct increase in calcification, and the structure of the epiphyseal cap of the radius was somewhat indistinct and irregular. The heads of the metacarpals in the fingers showed very pronounced changes. The marking of the epiphyseal line, especially at the metacarpus of the middle finger was ragged and the epiphyseal zone completely washed out. The sternal end of the left clavicle showed similar changes, in addition to a subluxation which was established clinically.

The head of the right femur was distinctly flattened, the epiphyseal cap narrow, mushroom-shaped, and especially in the upper portion puffed up and projecting outward. Here also were to be seen several focal rarefactions, with certain areas showing a decided richness in calcium. The epiphyseal junction is practically absent and in its place are to be seen irregular projections of bone. The base of the acetabulum is thin and shows a distinct protrusion so that the head of the femur projects within the thin base of the acetabulum distinctly into the interior of the pelvis. The acetabular protrusion is not uniformly round but shows slight flattening of the roof and markings of the epiphyseal cap. There was also a distinct coxa vara. All the above findings were bilateral.

Throughout the treatment, which consisted of orthopedic measures together with baking and massage, the patient was free of clinical symptoms and never showed elevated temperature. This case is distinctly one of osteochondritis deformans coxae juvenilis duplex.

Among the various explanations offered for the etiology of this disease, that laying the responsibility at the door of disturbances of internal secretion appears to have a good deal in its favor. In the present case the young woman showed very distinctly the absence of certain secondary sex characters that are due to the ovaries. This endocrine deficiency can be produced surgically by castration, and since in the present case the deficiency occurred naturally, the term applied to it is "castratoid." In the case under discussion a thorough gynecological examination disclosed an infantile development; and it is concluded that the disturbances in ossification in the skeleton were in some way caused by the endocrine deficiency.

McWhorter, G. L. Operation on neck of femur following acute symptoms in a case of osteochondritis deformans juvenilis coxae (Perthes' disease). *Surg., Gynec. & Obst.*, May, 1924, xxxviii, 632–637.

A case is reported in a boy aged six, who limped on the right leg, had a pain in the front of the right thigh and a temperature of 100.5°F. for two days. He had previously been perfectly well. The left leg was normal. The right leg showed limitation of function at the hip, limitation of abduction, flexion and rotation of the thigh by muscle spasm. The right thigh at the groin measured 1.5 cm. larger than the left. The diagnosis on the basis of the clinical exam-

ination was early acute osteomyelitis of the neck of the femur.

An anterior arthrotomy of the right hip was performed. The capsule was opened and a clear fluid ran out. A small opening was chiselled into the anterior side of the neck of the femur as far from the epiphyseal line as possible, and some spongy bone was removed for culture. No gross pus was seen. A second incision was made over the lateral side of the shaft of the femur about 4 inches down from the great trochanter, and a small opening cut through the cortex. The bone appeared normal. The material curetted from the neck of the femur, cultured on blood agar plates, showed one colony of *Staphylococcus aureus* after forty-eight hours. Cultures from the joint fluid and the shaft of the femur were sterile. After operation there was an intermittent febrile reaction lasting about a week, with return to normal. Roentgenogram of the femur taken eleven days after operation showed the head of the right femur to be flattened and shorter than the left. The epiphysis was not uniformly dense. The decreased density was more marked on the upper and outer side, with increased density in the center. The inner side was more flattened, thin and quite irregular. The epiphyseal line was irregular. The inner portion of the epiphysis appeared to be infringed upon and almost fragmented. Beneath this there was a prominence of the metaphysis. The neck was somewhat broadened, which may have been due to the encroachment of the epiphysis laterally on the neck of the femur.

There was an area of decreased density in the neck near the intertrochanteric line. A second area of decreased density was seen in the shaft about 4 inches down. These areas were due to operation. The acetabulum, on careful inspection and measurement, was apparently slightly widened, and the center somewhat flattened and more shallow.

Two weeks after operation the sinuses were examined as a possible cause of the trouble. Both sinuses were involved, *Staphylococcus aureus* being found. The sinuses were treated by irrigation. The wound over the shaft of the femur healed by primary union. There was some discharge from the wound over the hip but there was no discharge when the patient left the hospital, apparently well on the twentieth day after operation. There have been no abnormal symptoms since operation, and the patient has been under constant observation for three years.

The case of Perthes' disease was operated upon earlier after acute onset of symptoms than any other reported case. The clinical picture and evidence seem to corroborate the infectious origin of the disease. There was a definite, active focus of infection in the maxillary sinuses with a history of exacerbations and nasal discharge. Following operation with osteotomy of the neck of the femur, the case progressed to a cure without the usual chronic course.

NUSSBAUM, A. Osteochondritis coxae juvenilis. Calvé-Legg-Perthes. *Deutsche med. Wchnschr.*, 1923, xlix, 849–850.

The incidence of this disease as compared with coxitis shows the following important characters. Osteochondritis coxae juvenilis occurs only in childhood (3.5 to 14 years), and it has repeatedly been observed that it is more prevalent in boys than in girls. The condition is usually unilateral. The clinical examination occasionally shows a reflex tension of the adductors. The movement of the hip joint is limited in a very characteristic fashion. Abduction is always considerably interfered with and rotation is usually diminished, while flexion (this is an especially important distinction from coxitis) is usually entirely free.

The prognosis of this condition is very good and the therapy should be purely conservative. The author has been able to observe exactly the same changes as are found in man by section of the vessels of the femoral head in the young dog. Microscopic sections show the spongiosa of the epiphysis of the head completely necrotic. No nuclear staining is found in the marrow and the bone canaliculi, and in contrast to this the cartilage remains alive. Joint and epiphyseal cartilage show all nuclei well stained, the cells being in fact increased and the cartilage expanded. It may be concluded, therefore, that the articular cartilage can remain alive and multiply without a direct blood supply. It probably receives its nourishment through the synoviae. These observations show that Perthes' disease is a primary necrosis of the bony portion of the femoral head caused by stoppage of the blood vessels. There occurs a disturbance in enchondral ossification of the previously normal epiphysis. This establishes the mechanism probably responsible, but there is no answer to the question as to the ultimate cause of the disease.

NUSSBAUM, A. The arterial vessels of the epiphyses of the femur and their relations to normal and pathological processes. *Beitr. z. klin. Chir.*, 1923–24, cxxx, 495–535.

The joint cartilage receives its nourishment from the synoviae. In the young individual there is a thin process which reaches to the spongiosa of the epiphysis, and which appears

to be dependent for its nourishment on the blood circulation of the subchondral marrow spaces. The epiphyses grow from the joint cartilage through enchondral ossification. The overlying cartilage layer of the exostoses corresponds to the articular cartilage.

Calvé-Legg-Perthes' disease of the hip joint (osteochondritis deformans juvenilis) is produced by an interruption of the blood supply of the epiphysis. The result is a total necrosis of the bone nucleus and a cessation of its enchondral growth. This occasions a slight difference in height between the affected and healthy epiphyses. A more pronounced depression of the bony head is due to a pathological fracture. The joint cartilage remains alive despite cessation of the blood supply. The cartilage contracts to a thickened mass (in the roentgenogram there is a widening of the joint space) because the penetrating capillaries are no longer able to keep it expanded. The actual cause of the interruption in blood circulation remains as yet unknown.

The effects of the circulatory interruption are always completely counteracted by reorganization of the head spongiosa from the periosteum (its synovial coat) of the neck of the femur; and the deformity of the whole head (nucleus and overlying cartilage), if it has occurred, is the only thing that persists.

Bloody operations on the head of the femur in the juvenile are to be discarded because they disturb the spontaneous restoration, and injure the joint cartilage which is the matrix for the subsequent growth of the epiphysis.

Perthes' disease is similar microscopically to arthritis deformans senilis. In the latter disease, however, disturbance of circulation as a cause has not been demonstrated. Since this is the case, these two diseases should be strictly differentiated. The microscopic changes in osteochondritis deformans juvenilis have no relation to those found in rickets. In the epiphyseal separation of the hip joint, disturbances of the circulation do not occur, as a rule.

Fracture of the neck of the femur is regarded as prognostically unfavorable when there is rupture of the nourishing arteries running through the synovial periosteum of the neck. In such a fracture the head fragment is practically completely cut off from nourishment because any blood supply through the ligamentum teres is either absent or inadequate. The bone-forming power of the synovial membrane covering the neck of the femur is good, at least in the young individual because it permits the reorganization of the whole epiphysis which has necrotized.

The above are the conclusions based upon anatomic studies upon experimental animals (dog and rabbit), and corresponding observations reported in the literature on human cases. The typical picture of osteochondritis deformans juvenilis was produced experimentally in the dog.

PERTHES. Osteochondritis deformans coxae. *Klin. Wchnschr.*, 1924, iii, 513–516.

A general review is given of the hip disease which has passed under such names as Legg's disease, pseudo-coxalgia Calvé, malum coxae Legg-Calvé-Perthes, quiet hip disease, osteochondropathia juvenilis parosteogenetica, coxa vara capitalis, and coxa plana. The author suggests that possibly the preferable name would be osteochondritis deformans, and if one objects to the implication of the "itis," then osteochondropathia deformans should answer all requirements of precise nomenclature. Since the original observations of the condition in the hip, it has been pretty well determined that similar processes occur in the epiphyses of other bones besides the upper end of the femur. There is still question as to the nature of this disease, but the clinical picture has been definitely established.

In the very early stages of the disease, the roentgenogram shows no change whatever except that the head on the affected side is in general somewhat smaller than the other. Next there occur in the interior of the head along the portions adjoining the epiphyseal plane, usually toward the internal side first, isolated rarefactions of the bone shadow corresponding to circumscribed disappearance of bone. Similar changes follow in the adjoining portion of the neck, and with extension of confluent areas the epiphyseal line is broken and the head, which in the high stage of the disease appears like a broken down ruin, becomes flattened out and compressed. The mild clinical symptoms present a striking contrast to the high grade alterations disclosed by the roentgenogram.

Serial roentgen pictures then show how the neck of the femur becomes thicker and shorter. The broadened and flattened head merges with the neck to a single mass with its margin approaching the trochanter. The acetabulum becomes shallower in an attempt to adjust itself to this change. The interspace in the bone shadows corresponding to the joint space and joint cartilage is often noticeably wide. Finally two different shapes of the head may result. More frequently we find the cylindrical shape such as is well known in arthritis deformans of adult life. Sometimes the head assumes a spherical shape, more rounded than normal. In both cases after recovery, the areas of rarefaction have disappeared and become replaced by

new bone with the head of the femur again showing a homogeneous structure.

The functional end result corresponds to the above shapes. In the spherical shaped head there occurs a complete restitution of normal function. Such patients walk practically without limping and as well as a normal person. They are free from pain and there are no limitations to motion nor is there shortening. Only the roentgenogram reveals the rounded, thickened head of the femur. In the more frequent cases where the head of the femur is cylindrical the hip joint has been transformed to a hinge joint. Movements of abduction are correspondingly more or less limited but function with this anatomical end result may still be quite satisfactory. So far as the few recovered cases under observation indicate these satisfactory end results may be considered permanent.

The only question of diagnosis is that involving differentiation from tuberculosis. Usually this should not be difficult. If, however, a doubt remains the condition should be treated as one of tuberculous coxitis.

The pathological-anatomical findings, as well as clinical and roentgenological observations give ample justification for considering osteochondritis deformans of the hip as a distinct disease entity unrelated to tuberculosis. An analysis of various suggestions as to pathogenesis leads to the conclusion that the typical picture of osteochondritis deformans of the hip is best explained as due to a combination of developmental disturbance with an external injury. The three following diseases are considered more or less related to osteochondritis deformans of the hip, namely, Köhler's disease of the second metatarsal head, Köhler's disease of the os naviculare pedis, and Schlatter's disease of the tibial tuberosity. In all of these somewhat analogous conditions one can assume with a great degree of probability some internal constitutional condition which leads to a loosening of the cartilaginous joint, which under the influence of very slight trauma and even without it, results in vascular rupture. This vascular rupture can then lead to the bone necrosis and the other sequelae.

PERTHES, GEORG, and WELSCH, GUSTAVE. The development and end results of osteochondritis deformans of the hip joint (Calvé-Legg-Perthes), and the relation of the disease to arthritis deformans. *Beitr. z. klin. Chir.*, 1922, cxxvii, 477–525.

Fourteen cases of osteochondritis deformans coxae juvenilis have been followed both clinically and roentgenologically from the beginnings of the disease to the final resulting condition. The final result is a recovery of the bone process, with excellent restitution of the function of the joint. The duration of the recovery process from the acute stage to cure has been found to be, on the average, four and one half years. Roentgenologically, the healing bone assumes very distinct and characteristic shapes which are described as either spherical or cylindrical (mushroom). The most striking feature is the contrast between the pronounced deformity of the end of the femur and the satisfactory restitution of hip motion in practically all cases. In the spherical form there occurs an especially favorable and practically symptomless functional recovery, while in the cylindrical form there is a fairly pronounced limitation of motion. In 2 cases under observation for thirteen years the complete cure was associated with good functional recovery.

From beginning to the end, the course of the disease is characteristic. It has no relation to the clinical entity commonly known as arthritis deformans of the adult. The disease is also quite distinct from arthritis deformans juvenilis, and evidence shows that there is no gradual transition of Perthes' disease into arthritis deformans of adult years. Observation of these cases shows that such therapeutic measures as fixation and extension bandages produce no noteworthy effect upon the course of the disease. On the other hand, there is no indication for operative treatment because good spontaneous recovery takes place practically uniformly.

The descriptions of the 14 cases are given in detail, together with drawings illustrating the osseous changes.

REICH, H. The clinical features and etiology of Perthes-Calvé-Legg's disease (osteochondritis deformans juvenilis). *Schweizer. med. Wchnschr.*, 1923, liii, 1141–1147.

Perthes' disease is undoubtedly more frequent than is assumed and it is believed that a large number of those cases that are today treated as tuberculous coxitis are in reality cases of Perthes' disease. Six typical cases are described and pictured. In order to understand the roentgen findings it is important to know something of the pathological-anatomical features. The intensity of the pathological process, its localization and the age of the individual all modify the roentgenographic aspects. The roentgen picture shows typical changes which cannot be confused with that of any other malady and is consequently the best aid in the diagnosis and in the study of the course of the disease. Diagnosis is easy in the advanced stages but in the early stages there may be some difficulties. There are cases in which the clinical symptoms are present before the appearance of

any roentgenographic changes. In such early cases a negative von Pirquet test for exclusion of tuberculous coxitis is of great importance.

In the roentgenogram the destructive process does not always appear first at the epiphysis. The first changes may occur in the neck of the femur, usually directly below the epiphyseal line. After this there comes involvement of the head. This necrosis appears as irregular, focal rarefactions in the bone. These become more numerous and larger so that the head may break up into several pieces. It changes shape, becomes flattened and smaller, and finally works down over the neck. The neck also broadens by the same process and may be very much [illegible] the epiphyseal line. The articular space is usually wide which is in contrast to the narrowed zone in tuberculous coxitis. This distinctive feature is due to the fact that the articular cartilage is never involved in Perthes' disease. Because the articular cartilage is not affected and the process takes place in the interior of the head of the femur, we frequently find that the clinical symptoms are relatively insignificant compared with the actual pathological change, as revealed in the roentgenogram. The roentgenogram also permits differentiating Perthes' disease from coxa vara. Congenital hip luxations are not difficult to differentiate.

The course of the disease is chronic, lasts several years, during which there is a complete transformation in the shape of the upper end of the femur. In the end stage abduction and rotation are usually permanently affected. The patient has no objective symptoms with the exception of the rather frequent residual slight limp. The etiology of the disease is still unknown. It may be produced probably by a variety of causes. The general constitution and especially the activity of the thyroid play a larger rôle than is at present believed.

The best therapy is conservative. Patients with few exceptions are free to go about but should avoid any excessive strains. In order to maintain a maximum of abduction and rotation the author recommends massage, brine baths and passive movements.

SHEDLOV, ABRAHAM. Perthes' disease—osteochondritis juvenalis. *Journal-Lancet*, 1923, xliii, 488–494.

A description is given of a case occurring in a boy, aged nine, who began to limp seven months previously but had no symptoms of pain at that time. The limp disappeared for a week or two, but reappeared again. There was no tenderness on palpation, slight atrophy of the gluteal muscles on the right side, and the muscles of the thigh and calf on the affected side were softer than on the sound side. There was no shortening of the limb. Abduction was slightly limited, while rotation, fixation and adduction were normal. The boy's temperature was 101°F. at the first examination, but this was due to an acute tonsillitis. A few carious and abscessed teeth were noticed. The von Pirquet and Wassermann reactions were negative. The roentgenographic findings at the hip were typical. The epiphysis of the head of the femur was flattened and irregular in outline, with the epiphyseal line indistinct. There was little change in the joint space. The whole pelvis on the affected side, as well as the upper part of the shaft of the femur, showed a decreased bone density and atrophy.

The treatment was directed against weight-bearing, and the prognosis seems good (the tonsils and abscessed teeth have been removed).

SINGER, WALTER. Osteochondritis deformans juvenilis. *Monatschr. f. Kinderh.*, 1923, xxvi, 123–165.

A description is given of 2 cases treated in the Children's Hospital, Basel, and under observation for several years. These cases are described in detail and illustrated by roentgenograms. In addition, the literature has been reviewed and the various aspects combined so as to give a complete picture of the condition.

This picture may be summarized as follows: Osteochondritis deformans juvenilis presents clinically, and especially roentgenologically, a distinct and characteristic pathological picture of the hip joint in the child. The disease begins only exceptionally before the third year of life and is rare after the first decennium. As a rule, the disease progresses with slight pains in the hip and with insignificant disturbances in motion, and it is often accompanied by subfebrile temperatures. Slight limping, limitation of abduction, and a positive Trendelenburg phenomenon are three of the most constant symptoms. After an interval of one to three years, rarely after a greater interval, the subjective symptoms disappear. Juvenile osteochondritis localizes in the head of the femur at the epiphyseal line, and involves also the adjacent portion of the body. The head breaks down, as is shown clearly in the roentgenogram, into several segments which later fuse together. The epiphyseal line becomes irregular and the shaft thickened, while the joint space becomes broader. Finally, there results a pronounced pancake-shaped flattening of the head and a thickening of the neck of the femur as a permanent deformity. The immediate results of this deformity persist after "cure" as slight limitations in the excursions of the hip joint, especially a distinct limitation of abduction and

occasionally also a slight limping gait and a coxa vara posture.

In distinction to tuberculous coxitis, with the early stages of which juvenile osteochondritis is frequently and easily confused, the prognosis as regards functional restitution is practically always a good one.

The few pathological-anatomical studies made on the subject have shown underneath the undamaged cartilage layer covering the epiphysis the presence of either unossified cartilage islands (Perthes, Riedel), or subchondral disappearance of bone (Frangenheim), or else necrosis (Riedel). The epiphyseal line was always observed broken up. Most observers, especially Legg and Wideröe, assign the causative rôle to trauma. An important etiological rôle is also assigned to rickets by Calvé, Fromme and Schulthess. Recent reliable observations have also brought out in many cases of osteochondritis the presence of local, extremely mild inflammations, perhaps of an infectious rheumatic nature. Such appears to have been the condition in the 2 cases described by the author. It is possible that each of the three etiological factors mentioned may alone or in combination cause a local disturbance in circulation in the region of the epiphyseal line of the head of the femur to produce the clinical picture known as osteochondritis deformans juvenilis. It may be that congenital deviations from the normal may have a predisposing tendency in certain cases.

So far as regulating the course of the disease is concerned, therapy is practically powerless. On the other hand, suitable immobilization will cause relief from pain in a very short time, and the unnatural posture later assumed may be corrected by suitable measures.

Tillier, R. Deforming osteochondritis of hip joint. *Lyon chir.*, 1924, xxi, 464–484.

The theories on the nature of this condition fall into two groups; osteitis of the epiphysis, infectious or non-infectious; the other that osteochondritis is congenital articular malformation. There seem to be three periods in osteochondritis, the period of beginning, the period of activity and the period of definite consolidation of the lesion. In the beginning of the affection, there is slight limping, with certain limitations of certain movements, with sometimes fleeting pains, but especially fatigue brought on by walking. Such a condition is usually diagnosed as coxalgia. It is often difficult to determine exactly a diagnosis in such cases, because of the slight symptoms, a disproportion between general health of the subject and the lesion, more often a lack of uniformity of the multiple symptoms; there are often indications of apparent arthritis, then again these indications are slight or almost lacking. It is here that the roentgenogram is of the greatest importance; it is, in fact, the key to the diagnosis.

The roentgenogram, however, shows calcification of the bones only, and not the cartilage. However, when the roentgenogram of the epiphysis shows a nucleus of ossification to be small, irregular and fragmentary it permits of diagnosis of osteochondritis. The head of the femur shows a heaped-up appearance, enlarged somewhat in a later stage. Here the roentgenologic interpretation is simple. The osteochondritis then is affecting not only the epiphysis, but the whole fertile region of the upper femur.

The modifications of the trochanter are variable, but exist in many cases. There may be fragmentation of the ossification in the region of the head of the femur, abutting finally to a deformation of the apophysis.

There is little change in the form of the cotyloid cavity; at least irregularities found are hard to distinguish from normal irregularities, and it is difficult to come to any conclusion as to pathologic condition. Most important are the modifications of the general form of the cavity; these are undeniable, but correspond to secondary lesions of adaptation.

It is difficult to conceive the difference between immobility due to coxalgia and the same state due to osteochondritis in the child.

The irregularity and fragmentation of the epiphysis is characteristic. The neck of the femur is compressed. Here the interpretation of the roentgenogram is simple. Modifications of the trochanter are variable; when present it takes the form of fragmentation of the ossification center resulting ultimately in deformation more or less accentuated in the apophysis. Changes in the socket are slight, the roentgenogram showing only modification at the base of the cavity, but for that matter, the edge of the socket normally is variable. More important are the changes in the general form of the cavity, which are undeniable, corresponding to secondary lesions, and belong to the secondary phase, that of activity or evolution.

It is indeed difficult at times to diagnose osteochondritis because of the similarity of the symptoms to other similar affections, so that no strict relation between symptoms and this disease can always be made. Osteochondritis does not resemble either clinically or roentgenologically the lesions of osteo-articular affections of infectious origin. The comparison between osteochondritis and congenital luxation of the hip have many points in common, and frequently in association, similar evolution which is in favor of a relation between the

two. It is probable that luxation and osteochondritis have a common congenital origin by malformation; if the head is reduced it becomes luxation, and if the head is irregular, but the volume sufficient, it is osteochondritis, with the ultimate consequences appearing in the course of growth and homologues will be met in certain congenital luxations after reduction.

VIGNARD. Two biopsies in two cases of juvenile deforming osteochronditis. *Arch. franco-belges de chir.*, 1922, xxv, 1088–1091.

Two case reports are given in some detail.

I. Young shepherd, fourteen years old, who entered the Charitié de Lyon Feb. 10, 1922; no significant history. The affection actually began about a year previously with pain in the right thigh (hip). The pain was almost continuous. It was only by chance that a physician was consulted regarding this, for he was examined primarily for an eruption of the face; the thigh was examined and the physician advised hospitalization. The boy was rather slightly developed for his age. There was slight atrophy of the right thigh; it measured 20 cm. at the trochanter. There was apparent shortening of the limb but not true shortening, because of flexion, adduction and external rotation. Flexion is possible up to 80 degrees; abduction is slight or lacking. The various movements are not very painful; percussion of the large trochanter causes pain at the joint. Palpation of the inguinal fold shows a slightly enlarged gland. Walking is only slightly painful, but the patient shows marked limping.

Roentgenogram shows the head (of femur) deformed, flattened and the contour softened. The thickened neck (of the femur) has lost some of its length and is compressed to the side of the trochanter. The contour of the cap is confused; the osseous tissue appears to be rarefied on the opposite side, which does not present any symptoms, the epiphysis appears flattened, spread and run over the neck above and below. Intervention on March 28, 1922. Opening of articulation. Nothing in the synovial membrane. Luxation of the head outside of the socket. The head is compressed; there seems a sort of swelling as if it has been pushed back from the side of the trochanter. Under the swelling emerged a conical head faced with cartilage which appears greenish and unpolished. Two pieces of bone were removed, about 1.5 cm. long, of the appearance of ivory which appeared to be deposit. The socket was not as deep as is normal and was without any roughness, without any crest, without any supernumerary cavity. The deposits were cultured and washings inoculated into guinea pigs without any results. The opening was closed, plastered; the plaster was removed in May, 1922. On June 20, 1922, ankylosis of the hip and adduction of the foot is inside the line omb. pubienne. Atrophy of the quadriceps. On Sept. 20, 1922, the patient was in the same state.

II. Aged nine, came to the author for treatment Feb. 17, 1922. The affection began two years previously with pain in the fold of the groin of the right side. This existed only when the patient was walking. Good general health; no increase in temperature. The patient limped slightly. Spontaneous movements free; only the movement of abduction of the right thigh is limited. No pain on pressure.

Roentgenogram: Right, flattening of the head of the femur, which appeared wavy and appeared spread out in the neck. Great enlargement of the neck of the femur. Slight degree of coxa valga. Left, slight flattening of the head of the femur, enlargement of the neck and interligned articulation which is free. On both sides the socket is slightly swollen, but nevertheless the contour is distinctly defined.

March 21, 1922: opening of the hip joint. Luxation of the head which is absolutely round, shining and normal. Nothing in the socket was found by curettage in the nature of roughness, crest, or false cavity. (There was postoperative articular hematoma which necessitated drainage for twelve days.) July 27, 1922: all movements are possible. There is no limping. Roentgenogram showed the head in a normal position. There was slight irregularity in the socket on the side operated upon. In spite of the postoperative complications, this operation was successful in bringing about normal movements in the joint. The author is frank in not understanding exactly the reason for the good result obtained in this case, except that it be due to removal of cartilage in the joint which constituted a zone of adherence between the head of the femur and the socket. The author does not attempt to explain the etiology or pathology of deforming osteochrondritis.

ROENTGEN DIAGNOSIS

ABRAMOWA, ALEXANDRA. The problem of exostosis bursata. *Zentralbl. f. Chir.*, Nov. 21, 1925, lii, 2649–2655.

The pathogenesis of exostosis bursata is still unexplained. The various theories offered do not explain the origin of the mass which consists of spongious bone near the new bone formation in free and pedunculated joint bodies.

The diagnosis is rather difficult, especially when the tumor lies deep under the muscles,

as for instance, at the femur. The discovery of free bodies in the tumors simplifies the diagnosis as does also the position at the joint ends of the tubular bones or at those portions of the flat bones which possess a layer of germinal cartilage during the growth period. The position underneath a muscle or a tendon also simplifies the diagnosis. Occasionally one is able to elicit the characteristic muscle sound by some motion of the extremity. This symptom has been regarded by some as an important diagnostic sign. The most exact method of diagnosis is, naturally, to be found in the roentgenography of the condition.

A description is given of a case occurring in a woman aged forty-eight, who complained of a tumor of the right leg which caused no pain but interfered with walking. The roentgenogram showed a pedunculated growth arising from the posterior tibial surface and having a cauliflower-like appearance. The large tumor consisted of several portions which were connected by peduncles to the main growth. Free bodies were also present.

Operation disclosed the tumor consisting of three thin-walled sacs which were apparently filled with small stones. The patient made an uneventful recovery. The case is of unusual interest because exostosis bursata with free bodies within the capsule does not occur frequently. This tumor is regarded as benign, arising from the epiphyseal portion of the bone. It consists of bone and cartilage tissue covered on the surface by a connective tissue capsule.

ARNONE, GIOACCHINO. The appendix in normal subjects. *Radiol. med.*, January, 1926, xiii, 32–39.

The normal appendix is not permeable to feces and therefore not to opaque solutions, and so it is not visible in the roentgen picture. In a series of more than ten thousand roentgenograms taken for the most varied diseases, in which barium had been given by mouth, the appendix was visible in 15 per cent. Deducting about a thousand cases in which there was a history of appendicular colic the percentage fell to 5 per cent. This shows that pain in the appendix is more frequent in cases in which the appendix is permeable to barium salts. The appendix is also invisible in many cases of chronic and also of acute appendicitis. In some of these cases the appendix is primarily impermeable as it has not yet been injured sufficiently to become permeable and in others it has become permeable but has been destroyed or closed by an inflammatory process or an accumulation of fecal matter. There is an intermediate stage between the appendix which is absolutely normal and one distinctly pathological, in which the appendix is visible roentgenologically, and yet there are no very pronounced macroscopic or microscopic changes. The appendix in which there is only a slight deviation from normal is barely visible in the form of a hook; it fills rapidly at the same time with the cecum, and only for a short distance; its lumen is uniform and conical; it empties rapidly before the cecum. If the changes are more pronounced it fills for a length of several centimeters and its lumen shows enlargements and constrictions which give it the appearance of a rosary. If the column of barium is interrupted at several points, it is approaching a frankly pathological condition. If the appendix does not fit with the cecum it indicates spasm of the opening or an obstruction by a foreign body or feces, which may cause appendicular colic. If it is slow in emptying, that is, if it contains barium after the cecum is empty it may be due to various conditions. Undoubtedly one of the most frequent causes of appendicitis is the entrance of feces, worms or foreign bodies into the lumen of the appendix, this penetration being favored by constipation and imperfect canalization of the colon, principally due to ptosis. In these cases roentgen examination shows the mechanism by which the appendix passes from a normal to a pathological condition. Prolonged stimulation of the appendix by these conditions leads at first to a temporary condition of irritation with free intervals and finally a state of chronic inflammation.

The author concludes that if the appendix is permeable to barium salts it indicates a congenital or acquired anomaly which furnishes a predisposition to appendicular colic or chronic appendicitis. The more dilated and elongated the lumen and the greater the irregularity of the caliber, the more the appendix is twisted or adherent and the slower its emptying, the greater the degree of the lesion.

BALLI, RUGGERO. Sesamoid anomalies of the foot or supernumerary tarsal bones? *Radiol. med.*, October, 1925, xii, 707–709.

In Radiol. med., 1925, xii, 467, Sessa wrote an article under this title describing four opaque bodies which he found in the sole of the right foot of a woman aged thirty-two. He concluded that the bodies were sesamoid bones and asked for an opinion on the question by other roentgenologists. Balli agrees that they were sesamoid bones of the flexor tendons of the sole of the foot, but of which tendons? He concludes that the shadow found on dorsoplantar projection in the middle of the portion of the foot anterior to the astragalus was in the tendon of the posterior tibial muscle, and

refers to anatomists who describe a sesamoid in this tendon. With regard to the other three shadows he concludes that the one between the tarso-metatarsal bones and the plantar aponeurosis is a sesamoid of the tendon of the flexor longus hallucis and refers to a description by Shepherd of such a sesamoid. But sesamoid bones may be divided into several fibrocartilaginous nuclei and he concludes that this was the case with these three shadows and that they represent three fibrocartilaginous nuclei of a sesamoid of the flexor longus hallucis.

BECCHINI, G. Atelectasis of the lung from foreign body. *Arch. di radiol.*, July–Aug., 1925, i, 651–653.

The author describes a case in a child of six who swallowed a melon seed. A roentgenogram taken at the time showed a cloudiness of the left base which indicates that the seed had completely obstructed the bronchus of the lower lobe and caused collapse of the lung in the corresponding territory. After about two months the child had fever preceded by chill; there were rather large moist rales along the left paravertebral line, vocal fremitus was abolished and there were bronchophony and pectoriloquy; there was dullness over the whole left side. Roentgen examination two days later showed typical complete atelectasis of the lung on the left side. The seed which had obstructed the bronchus at first had become the starting point of an inflammation, presumably at the point where the left bronchus divides into its two branches, which obstructed the upper bronchus also and caused atelectasis of the lung aerated by it. Fortunately an attack of coughing brought up the seed covered with pus a few days later and a roentgenogran taken soon after showed much better aeration of the base. In the upper part some opacity remained, due probably in part to diffusion of the suppurative process and in part to atelectasis still persisting from the stenosis of the bronchus caused by it.

BECK, OSCAR, AND SGALITZER, M. Bronchography with the aid of the laryngeal catheter. *Zentralbl. f. Chir.*, July 11, 1925, lii, 1537–1541.

It is to be expected that pulmonary diagnosis will be considerably improved and extended by bronchography; and the discovery and localization of bronchiectases which offer some of the most difficult problems in roentgenography are greatly aided by this method.

The authors have developed a method making use of a self-retaining catheter inserted into the larynx, through which is passed 40 per cent iodipin (Merck). By this means the iodipin is at no time in contact with the mouth cavity. A roentgenoscopic observation is made of the entrance of the iodipin into the single bronchi. A convenient device is arranged for regulating the pressure of the inflowing contrast material according to need. The patient is completely free to move around during the examination and the roentgenologist is entirely independent of the laryngologist during the examination. By means of direct roentgenoscopic control the method has the advantage that the quantity of iodipin can be regulated according to the needs of the moment. The material is introduced until the question of diagnosis is answered and then stopped. The quantity introduced may vary from 5 to 50 c.c. The larynx is anesthetized before the catheter is introduced. During the introduction of the iodipin into the bronchial tree a cough reflex may occasionally occur. This may be reduced by a very fine spray of cocaine and adrenalin introduced through the glottis into the trachea.

The iodipin apparently covers the interior walls of the bronchi but usually leaves the lumen free, or the lumen is cleared within a few minutes by coughing. Only in occasional cases does the material flow into the alveoli where it may remain for days or weeks until finally absorbed. The iodipin also remains often for a long time in lung cavities, which may be of some significance therapeutically. Symptoms of iodism as a result of the injections have never been observed by the authors. The degree of stiffness of the thoracic wall, the elasticity of the lung and pathological changes in the latter all play a rôle in the elimination by coughing or at any event in the gradual absorption.

BIANCHI, GIOVANNI. Roentgen appearance of peristalsis in diaphragmatic hernia of the stomach. *Arch. di radiol.*, July–Aug., 1925, i, 639–644.

None of the roentgen signs theretofore given for the differential diagnosis between eventration and hernia of the diaphragm are reliable, and therefore the author suggests a new one which he believes is certain, namely, peristaltic movements of the wall of the stomach at the dividing line between the thorax and abdomen. The part of the stomach most frequently drawn into the thorax in rather voluminous hernia is the mesogastric portion, that is, a region where the peristaltic waves are clearly visible. Generally the herniated stomach tends to assume a horseshoe form, that is to say, the greater curvature is turned upward, the cardia and pylorus being the lowest points and the lesser curvature turned downward. He describes and gives two roentgenograms of a case

in a young man aged twenty-eight. In this case of gastrocolic diaphragmatic hernia the peristaltic waves of the stomach were seen in the form of a division of the line, which divided the thorax from the abdomen into two lines intersecting each other and moving alternately from above downward and from below upward. The two lines were the two curves of the greater curvature of the stomach. This appearance of peristalsis in a stomach distended with gas and directed approximately in the same direction as the bundle of roentgen rays is rather hard to demonstrate because of the thinness of the line at certain moments and the slowness of its movements, and the fact that it cannot be demonstrated with contrast medium which masks the movement, and when the liquid is in contact with the upper border of the stomach only allows one contour to be seen. But the author believes that this sign of peristalsis at the boundary between the thorax and abdomen is the surest means of differentiation between hernia and eventration of the diaphragm.

Bonanno, Matteo. Roentgenological study of gastric function in Biermer's anemia. *Radiol. med.*, November, 1925, xii, 749–757.

Pernicious anemia is always accompanied by stomach symptoms and many authors think the stomach plays a leading part in the pathogenesis of the disease. Some think that the premature emptying of the stomach which is often observed is due to hypertonia and hyperkinesis of the stomach while others believe that it is due simply to incontinence of the pylorus.

The author made a roentgenological study of this question in 8 cases. The stomach was found normal in only one of these cases; in 3 cases the stomach was small, peristalsis was limited and emptying was rapid on account of incontinence of the pylorus; in 2 cases the stomach was hypotonic and ptotic, while in the 2 others there was gastric hypertonia and hyperkinesis.

He believes that these differences are explained by the varying anatomical conditions of the wall of the stomach, as hypertrophic gastritis is always accompanied by gastric hypertonia and hyperkinesis, while in atrophic gastritis there is a decrease in the size of the stomach with incontinence of the pylorus. These different pictures may appear at different stages of the disease in the same patient, as a beginning hypertropic gastritis often evolves into an atrophic gastritis.

The picture of incontinence of the pylorus in Biermer's anemia may be confused with that of incontinence due to sclerotic gastritis, and one of the author's cases was so diagnosed. A differential diagnosis can generally be made by the clinical examination and the blood picture, but on careful examination there are differences even in the roentgen picture. In sclerotic gastritis there is such a great decrease in the size of the stomach that it is withdrawn beneath the costal arch with the pyloric end at the midline or even on the left; the stomach picture is continuous with that of the duodenum, there is no peristalsis and the stomach outline is immobile, while in all of the author's cases of pernicious anemia, although the stomach was decreased in size it was never so small as to be withdrawn beneath the costal arch, it was ox-horn in shape, the pyloric end was slightly to the right, the stomach outline was mobile and there was peristalsis, though in some cases it was torpid.

Boardman, Walter W., and McKenzie, Roger B. Cholecystography—its value as a diagnostic procedure. *Calif. & Western M.*, January, 1926, xxiv, 60–62.

The authors feel that in tetraiodophenolphthalein there is a safe and reliable method of studying some of the functions of the biliary system. Failure of visualization indicates disturbed function, usually the result of definite pathological processes in the gall-bladder or cystic duct. Such cases are considered essentially surgical, provided there is no conflict in the assembled findings.

Incomplete visualization after the intravenous method indicates some disturbance in biliary tract function which may be due to pathological processes in the cystic duct or gall-bladder. Such cases are kept under observation on medical treatment for a time before surgery is advised.

Normal visualization indicates a fairly normal functioning biliary system which, however, does not exclude slight pathological processes, but would certainly seem to contraindicate any surgical procedures except with the most definite clinical indications. Caution and experience are necessary in interpreting the results, especially after the oral administration of the dye. Above all, these roentgenographic findings must be correlated with the clinical findings.

Businco, Ottavio. Divided patella. *Radiol. med.*, December, 1925, xii, 812–820.

Businco describes two cases of divided patella. These cases are of interest as they may be confused with fracture and lead to mistaken diagnosis in medico-legal decisions. In one of the author's cases the anomaly was found on the side opposite the trauma while the patella of the injured knee was atrophic, but in the second case the anomaly was bilateral and was considered a fracture, the roentgenologist having neglected to make an

examination of the other knee. The patient was therefore awarded damages though he had no right to them.

Roentgenologically, divided patella does not differ from fracture. The chief point in differential diagnosis is that it is almost always bilateral and therefore in every case of examination for fractured patella the other knee should be examined also. Even in the exceptional cases in which the division is unilateral there may be morphological changes in the other patella which indicate the same process that has caused the division in the supposedly fractured one. In the author's first case it was the atrophy of the patella on the injured side which led him to make an examination of the other knee. Division of the patella always results from the presence of several centers of ossification—ordinarily two but sometimes more. The process of division is brought about by normal or exaggerated tension of the quadriceps, which results in the typical separation of the fragments. The causative factor which prevents the normal fusion of the centers of ossification is some pathological process which disturbs normal ossification, such for example as juvenile osteochondropathy. In the author's second case this etiological condition may have been rickets. The best projections for showing this anomaly are the tangenital projection and an anteroposterior projection a little oblique toward the outside. A lateral projection may hide it.

Chizzola, Giuliano. The value of roentgen examination in the study of mega-esophagus. *Radiol. med.*, December, 1925, xii, 806–811.

Some authors believe that the chief element in the etiology of mega-esophagus is spasm either at the cardia or, as claimed by some who deny the existence of a cardiac sphincter, in the sub-diaphragmatic part of the esophagus which they call the cardiac canal. According to another group of authors, mega-esophagus is caused by paralysis, degeneration or other changes in the walls of the organ. In support of this theory they refer to cases of post-traumatic and post-infectious dilatation of the esophagus from lesions of the fibers of the vagus and degeneration of the musculature of the esophagus. A third group of authors believe the cause lies in a congenital structural anomaly of the organ. Chizzola believes that too much stress has been laid on special characteristics of certain cases which occur only in one period of the disease, and not enough on the essential features common to all cases. He believes that roentgen examination tends to support the theory of the congenital origin of the disease. He finds that there is a parallelism between mega-esophagus and similar changes in other segments of the digestive tract (megacolon, dolicho-megasigmoid, mega-rectum and mega-duodenum). In certain cases mega-esophagus has been found by chance coexisting with mega-colon or dolicho-colon and he therefore thinks that a roentgen examination should be made of the whole digestive tract in cases of idiopathic dilatation of the esophagus. Also when there are such changes in other parts of the intestine a systematic examination should be made of the esophagus in order to prove the theory of the congenital origin of mega-esophagus.

Ciaccia, Salvatore. Sarcoma of the pelvis with special reference to roentgenological diagnosis. *Ann. ital. di chir.*, Apr. 30, 1925, iv, 321–332.

Two cases of sarcoma of the pelvis are described which illustrate the difficulty of roentgen diagnosis in this disease. In the first case the clinical signs were those of an acute infection; the patient had had a fall and pus was obtained on exploratory puncture. But roentgen examination showed changes characteristic of sarcoma along the inner border of the left innominate bone, and on very careful inspection it was possible to make out the outline of the tumor mass which was verified on autopsy. In the second case the clinical signs were those of malignant new growth but roentgen examination did not show any changes in the pelvic bones. Therefore the roentgen picture of pelvic tumors differs, depending on their localization and the direction in which they develop. The majority of such sarcomas involve the median part of the iliac bone and so cause changes in the outline of the crest and inner border which give the same picture of tumor as in the long bones. But if the tumor originates in the periosteum and develops outwardly into the soft tissues without causing any great change in the outline of the bone it is not shown on roentgen examination because its opacity is about the same as that of the surrounding soft tissues. Therefore tumor of the pelvis cannot always be excluded because it does not show in the roentgenogram.

Cignolini, Pietro. The upper boundary of medium and large effusions in serofibrinous pleurisy studied by means of light iodoleum. *Radiol. med.*, November, 1925, xii, 758–762.

It is hard to determine the upper boundary of an effusion by ordinary roentgenological examination as a thin layer of liquid cannot be demonstrated. The author has adopted what he calls light iodoleum for this purpose. It is a 10 to

25 per cent iodized oil diluted with sterile olive oil to 6 or 7 per cent, so that it floats on top of an effusion. He injects 6 to 10 c.c. of it as low as possible in the area of dullness, after having withdrawn an equal amount of effusion so as not to increase intrapleural pressure. The iodoleum rises rapidly to the apex of the pleura, where its upper outline is more or less arched, depending on the arch of the apex, and its lower level is horizontal, showing that it rests on the effusion. With change of position of the patient the line of the iodoleum changes, keeping always at the highest point, above the level of the effusion. This is due solely to its being lighter than the fluid of the effusion and therefore floating on top of it. It shows that the upper lobe of the lung is completely enveloped in a thin layer of exudate, even when clinical and ordinary roentgenological examination does not show it. Four illustrative roentgenograms are given.

D'AMATO, GIUSEPPE. Visibility of the gall-bladder by means of injections of tetrabromphenolphthalein. *Radiol. med.*, January, 1926, xiii, 39–55.

The normal gall-bladder can be rendered visible on roentgen-ray examination by the injection of tetrabromphenolphthalein. The author injects 40 c.c. with a Record syringe, taking great care to inject into the vein, for if any of the solution passes into the surrounding tissues it causes necrosis in a short time. The injection should be made very slowly, requiring not less than ten minutes. Almost always after some minutes there is nausea, vomiting, pain in the right hypochondrium and in the injected arm, sudden flushing of the face and a feeling of heat throughout the body. All these symptoms can be overcome very quickly by an injection of 1 mg. adrenalin, and the only real danger in the method is that of necrosis from injecting outside the vein, which can be avoided by careful technique. A roentgenogram is taken of the right half of the abdomen with a Potter-Bucky diaphragm centered on the middle of the 12th rib; rays of moderate hardness are used obtained from a thermoionic tube with a tension varying from 50 to 55 kv., and a charge of 30–40 ma., time of exposure varying from 3½ to 9 minutes, depending on the adiposity of the patient. The patient lies on his abdomen and must not breathe while the picture is being taken, keeping a position midway between inspiration and expiration. In five to six hours after the injection the gall-bladder is visible; at the end of sixteen to twenty-four hours the shadow is denser and smaller, and in forty-eight hours it has disappeared. These changes in form show normal elasticity and contractile capacity of the gall-bladder. If the shadow appears late or not at all it indicates that the cystic duct is occluded, but only in case the patient has not had uncontrollable vomiting, which produces reflex contractions of the gall-bladder and empties its contents so that the bromid cannot accumulate in it, and in case there is not functional insufficiency of the liver. If liver function is decreased, the kidneys act vicariously in place of it and present a shadow on the roentgenogram. But even if there is decreased liver function it does not prove that there is no interference with the flow of the bile. An illustrative case is described in which there was decreased liver function and also adhesions of the neck of the gall-bladder with the common duct which interfered with the flow of bile. Inflammatory processes of the bile ducts with swelling of the mucous membrane and decreased lumen of the duct may also retard the appearance of the shadow.

The site of the organ depends on various factors, such as the position of the liver in inspiration and expiration, the conditions of projection, pressure of the meteoric colon, etc. In a roentgenogram centered at the level of the 1st lumbar vertebra, with the patient lying on his abdomen and the diaphragm in a position midway between inspiration and expiration, the shadow generally appears on the paravertebral line somewhere between the transverse processes of the 1st and 4th lumbar vertebrae. In stout individuals with high position of the diaphragm it may be much higher than this, especially if there is meteorism of the colon. A case is described in which it was found on the mammillary line at the lower edge of the 11th rib. The position may vary slightly in the same individual in different roentgenograms. The size of the shadow varies considerably; if the gall-bladder is large but otherwise normal the shadow will be large in the first roentgenogram but successively smaller in the later ones showing normal contractility. But if it is permanently dilated from stasis, as may happen in processes which obstruct the lower bile ducts, such as cancer of the common duct, cancer of Vater's papilla or the head of the pancreas, chronic pancreatitis, stenosis of the second part of the duodenum, etc., there will be a shadow which is not very intense on account of dilution of the contrast medium by the stagnant bile, but which remains the same size in all the roentgenograms. Cirrhosis of the organ is shown by an abnormal and constant smallness of the shadow and abnormally slow emptying time due to the loss of contractile power.

Cholesterin stones appear as clear zones on the homogeneous density of the shadow. These may be hard to differentiate from gas bubbles of the colon superimposed on the gall-bladder

shadow. For the purpose of differentiation the author follows the first roentgenogram by two others, one taken in a position of deep inspiration and the other in expiration. He describes a case of calculus complicated by cirrhosis, and concludes by emphasizing the great value of the method in the diagnosis of diseases of the bile tract.

De Langen, C. D. The chemical composition of gallstones in Dutch India and their diagnosis by means of roentgen rays. *Geneesk. Tijdschr. Nederl. Indie*, 1925, lxv, 90–102.

Cholelithiasis is rare in the Dutch East Indies. Cholesterol and cholesterol-bilirubin stones occur very rarely, bilirubin-lime stones and calcium bilirubinate stones occur frequently and bilirubin stones most frequently. Unlike cholesterol stones which give poor roentgen shadows, the bilirubin-lime, the calcium bilirubinate and the bilirubin stones give distinct shadows.

The prevalence of pigment stones demonstrates the rôle of infection in the etiology of gallstones.

Duval, Pierre and Gatellier, Jean. Periduodenitis essentially stenosis. *Arch. Franco-Belges de chir., Brussels*, 1925, xxviii, 1–10.

The use of baryta and the roentgenogram gives direct proof of stenosis of the duodenum and is a ready means of diagnosing conditions resulting from this abnormality. The whole digestive tract in the region of the duodenum may be studied at the same time, to determine exactly the extent of the stenosis and also what operative procedures may be necessary. Illustrations and drawings are given.

Engel, Gilson Colby. Cholecystography. *Boston M. & S. J.*, Dec. 10, 1925, cxciii, 1102–1105.

A review is presented of 10 recent papers and a summary is given of the anatomy and physiology of the gall-bladder, the compounds used in cholecystography, the methods of administration, the reaction to the compounds and the visualization of the gall-bladder.

Fasiani, G. M. Roentgen picture of the male urethra. *Arch. ital. di urol., Bologna*, April, 1925, i, 487–511.

Pieri was the first to photograph the male urethra by means of injecting an opaque liquid. But it was impossible in his dorsoventral position to show the whole urethra. Haudek improved the method by placing the patient in an oblique position so that the frontal plane of the body is inclined at about an angle of 45° to the plane of the table. In this way the whole course of the urethra can be shown. Any of the contrast media used for cystography or pyelography may be used, but Fasiani has found that the only one that does not cause any irritation is 45 per cent gelatinous sulphate of barium in aqueous suspension. Haudek found that the posterior part of the urethra is visible only during the injection, because when the pressure stops the liquid flows into the bladder immediately, so that it was necessary to take the picture during the injection. But Fasiani finds that a picture of the posterior urethra can be obtained by filling the bladder with opaque liquid and then telling the patient to empty the bladder and taking the picture during micturition. It generally takes 10 to 12 c.c. of liquid to fill the normal urethra of a young man, but in cases of stricture it may not hold more than 10 c.c., while in the above described method of filling the bladder and having the patient empty it 100 c.c. may be required. The most serious complication that may occur is the penetration of the contrast liquid into the corpora cavernosa and thence into the blood. A roentgenogram is given of a case in which this occurred. Care should be taken to avoid rapid increase of pressure in making the injection, and special care should be exercised if there is any suspicion of lesions of the wall of the urethra.

Roentgenograms of the normal urethra are shown, as well as ones with congenital and post-gonorrheal stricture. This method is better than any other for demonstrating the exact site, number and location of strictures, diverticula and fistulas of the urethra. Burden reported two cases of post-gonorrheal stricture in which there was a shadow parallel to that of the urethra, which he interpreted as a false route taken by the urine. Fasiani has seen two similar cases, but thinks these canals represented the excretory duct of the bulbo-urethral glands or the ejaculatory canal, and supposes that the inflammatory process of the wall of the urethra had affected the walls of these canals and rendered them permeable to the contrast liquid, though they are normally closed to the passage of substances from the urethra. Similarly in a man operated upon by orchidectomy for tuberculosis and with tuberculous lesions of the bladder and left seminal vesicle there was a shadow near the posterior margin of the middle portion of the pelvic urethra which was undoubtedly an abnormal shadow of the seminal vesicle, into which liquid does not pass from the urethra under normal conditions. In a case of epithelioma of the urethra, Haudek demonstrated extension of the morbid process by this method when it could not be demonstrated either by sounding or urethroscopy.

FRAIKIN and BURILL. Three cases of perigastritis. *Bull. et mém. Soc. de radiol. méd. de France, Par.*, 1925, xiii, 23–26.

Three case reports of perigastritis are given in which the roentgenologic examinations confirmed the clinical diagnosis. In the first case the roentgenologic examination showed perigastric adherence of (1) the superior part of the medio-gastric zone posteriorly and internally; (2) of the pyloro-duodenal zone. The second case showed adherence of the superior part of the medio-gastric zone, due probably to an old ulcer. It is necessary in order to obtain the most from roentgenologic examinations to make observations in different positions, anterior, posterior and lateral, with the patient in both the vertical and horizontal positions.

FRÄNKEL, MANFRED. Irradiation of the endocrine glands in carcinoma. *Deutsche med. Wchnschr.*, Nov. 27, 1925, li, 1989.

This is a continuation of the controversy between Fränkel and Halberstädter. Fränkel believes that a form of therapy which involves such very profound and hazardous effects as are produced by intensive radiation therapy cannot be regarded as very much of an advance in medical practice. Intensive radiation therapy becomes only another and a worse form of surgical therapy since it does not attack the disease itself; and in addition it may cause serious injury to neighboring organs. Fränkel believes that intensive irradiation and irradiations with relatively high doses should be forbidden. Certainly this form of treatment following operation is incorrect, especially in mammary carcinoma. In addition to these aspects there is good reason to believe that cancer instead of being a local disease is probably a general one.

Halberstädter in his concluding comment points out that the problem is not that of difficulties incurred in local roentgen treatment, but whether it is possible to cause a disappearance of cancer in man by irradiation of the endocrine glands with simultaneous exclusion of the local roentgen effect. This latter view is denied on the basis of personal experience.

GIOVETTI, VITTORINO. Another case of ascarides of the small intestine discovered by roentgen examination. *Radiol. med.*, October, 1925, xii, 669–674.

Giovetti reviews the history of the roentgenological discovery of *Ascaris lumbricoides* in the intestinal tract, describes two cases reported by Busi and a new case of his own. The worms appear in the form of delicate transparent lines, smooth, regular, 4–6 mm. broad and 10 to 40 cm. long with pointed ends. They are crossed by opaque stripes caused by the valvulae conniventes. A delicate opaque line may also traverse the worm longitudinally, due to its having swallowed barium, recalling the appearance of an elastic sound containing a metal mandrin. Two roentgenograms of the author's case are given, illustrating the appearance of the ascarides.

His case was in a woman of forty-eight who eight months before his examination was suddenly taken in the night with violent abdominal pain and vomiting. A purgative was given and the pain stopped but the attack recurred in two months and again in four months. The last attack was more violent than the others. A roentgenogram showed nothing abnormal in the stomach or duodenum but showed a typical ascaris in the jejunum. Operation showed ascaris appendicitis.

Roentgen examination for ascarides should always be made in obscure cases of intestinal disease.

Animal experiment has also shown that ascarides pass one stage of their existence in the lungs. In some of the experiments on animals they produced a fatal bronchopneumonia. It is quite possible that this also explains certain diseases of the respiratory tract, especially bronchopneumonia in infants.

GLOGAUER, OTTO. Roentgen diagnosis of bronchial stenosis. *Med. Klinik*, Nov. 13, 1925, xxi, 1724–1726.

A report is given of the use of iodipin to fix the diagnosis in a case suspected of being bronchial stenosis caused by tumor. The results obtained with the iodipin were completely satisfactory in that the diagnosis was definitely fixed. The patient, standing upright, received 20 c.c. of the 20 per cent iodipin through a catheter. In the roentgenoscope a portion of the iodipin was seen to flow down to the lower wall of the right lower lobe bronchus. The major portion of the contrast fluid was held back in the left main bronchus immediately below the bifurcation. This was caused by a malignant tumor from which the patient died. Autopsy confirmed the pictures seen by the aid of the iodipin.

GOSSET, A., and LOEWY, G. Cholecystography. *Presse méd., Par.*, 1925, No. 71, 1185–1188.

The authors have changed their technique in cholecystography in that they now use the tetraiodophenolphthalein instead of sodium tetrabromphenolphthalein with much better results and without the toxic effects of the latter. The toxicity accorded this product by Graham is due to impurity of the salt; in the pure form, it is relatively non-toxic. It is

necessary to inject only one-half the amount of tetraiodo in order to secure the same picture as a full amount of tetrabrom; in this small quantity it is non-toxic. The quantity injected into humans is 4 centigrams per kilogram, which is far below a fatal dose. The sodium salt of tetraiodo phenolphthalein is preserved in hermetically sealed dark bottles because it is readily changed by the air. It is easily soluble in water; the concentration used varies with different authors. The authors use a 5 per cent solution. It is boiled before injecting, and may be kept for 24 hours before use without danger. It may be administered either intravenously or by mouth. Observations either roentgenoscopically or in roentgenograms show clearly the outline of the gall-bladder and calculi if present. Administration by mouth is quite sufficient in distinct cases, but not as reliable as intravenous injection. The tetraiodo is best for intravenous; a correct diagnosis is possible in 85 per cent of the cases. It is, however, impossible to discern slight lesions in the gall-bladder by this method. In spite of this, the test given is of great value in diagnosing larger lesions and calculi in the gall-bladder.

HEUSER, CARLOS. Roentgenography of the pubis and the diagnosis of syphilis. *Semana med., Buenos Aires*, Oct. 1, 1925, xxxii, 862–863.

The author calls attention to a sign which he has found in all old cases of syphilis on roentgenography of the pubis. On the lower and external part of the ischiopubic ramus of the pubic bone and sometimes on the lower border of the ischium, there are exostoses varying from one to several millimeters in length, sometimes several of them side by side. This symptom is found in men or women with old syphilis or in the children of syphilitics. Sometimes these exostoses are also found on the crest of the ilium, and in these cases the syphilis dates back at least thirty years. The author describes the case of a woman six months pregnant who complained of intense pain in the pelvis, and roentgenography showed these exostoses. Her mother had had aneurysm of the aorta and her father tabes. The child was born with an enlarged liver and died in twenty days. He mentions this case as showing that this sign may reveal syphilis in cases in which it has not been suspected. He has found it in 48 cases.

HILL, HENRY G. Osteomyelitis. *J. Tennessee M. Ass., July*, 1925, xviii, 65–72.

The demand for operation in acute osteomyelitis, before subperiosteal abscess develops is sometimes hard to meet in practice. There are some cases in which it is absolutely impossible to localize the process during the first twenty-four to thirty-six hours after onset. The diagnosis should be made before swelling in the soft parts occurs. During this period roentgen-ray examinations are negative. Superficial palpation in the region of pain usually reveals no tenderness, while prolonged deep pressure directly over the lesion will develop severe pain. This is the essential sign in the early stage of acute osteomyelitis.

The disease occurs usually in children and young adults. The extremities of bones near the joints are most frequently involved. The femur is the site of trouble in 50 per cent of cases and the tibia in 33 per cent. About one-third of the cases give a definite history of trauma. The death rate ranges from 20 to 40 per cent when a diagnosis is not made promptly and proper treatment instituted. The surgeon can be misled by negative roentgen-ray findings in the early stages of acute osteomyelitis, and in the author's experience this is the most common error in the diagnosis of the disease. "Watchful waiting" usually means the death of a large portion or of the entire diaphysis of the infected bone.

In chronic osteomyelitis all sinuses should be accurately mapped out from the roentgen-ray study before operative procedure has been instituted.

ROENTGEN AND RADIUM THERAPY

CUSHWAY, B. C. Practical application of radiation therapy in conjunction with surgery. *Illinois M. J.*, October, 1925, xlviii, 264–269.

Roentgen rays or radium combined with surgery are discussed in relation to the diseases best amenable to such a combination, under the headings glandular dyscrasias, benign tumors and malignancy. The most important of the glandular dyscrasias are exophthalmic goiter and toxic adenoma of the thyroid. A review of the statistics leads to the opinion that combination of surgery and irradiation will produce more than 70 to 80 per cent of cures, which is higher than can be obtained by one of these procedures alone. The roentgen treatment does no harm and in addition makes the case a better surgical risk. All the author's experience speaks at least for a trial of this form of therapy.

Another group of conditions consists of constitutional or idiopathic amenorrheas, menorrhagias or metrorrhagias; cases in which no pathological cause can be found other than a hypo- or hyperfunction of the ovaries or the

endocrines. In the author's experience 95 per cent successful results have been obtained by the use of roentgen rays without producing a permanent amenorrhea in any case, although an amenorrhea of from three to nine months' duration has resulted in a number of cases.

Among the benign tumors treated best by a combination of surgery and irradiation are nasal polyps. Definitely operative cures occur more often with radium than without it.

With respect to the treatment of malignancies the author hesitates at the present time to advise the use of radiation to the exclusion of all other forms of therapy as some have done. Only in the case of basal cell epithelioma has radiation alone given a very high percentage of cures. In other types of malignancy the percentage is about the same or slightly lower than when surgery alone is used. This of course excludes the large number of inoperable malignancies that require palliation by means of roentgen rays.

Brief review is given of the general results obtained in the combined treatment of carcinoma of the breast, of the bladder, of the cervix uteri and of the esophagus.

DENMAN, IRA O. The rôle of irradiation in focal infections and obstructive deafness. *J. Ophth., Otol. & Laryngol.*, November, 1925, xxix, 409–417.

There is an area between the nasopharynx and the tympanic cavity where no surgical instrument can reach and no topical application can be made. Radiation, by reason of its unlimited degree of penetration and its action in dissolving obstructive lymphoid tissue, produces beneficial effects in chronic focal infections.

The author eliminates the focus of infection by means of roentgen rays. The dose given must be lower than the erythema dose so as to injure no other cells besides the lymphoblasts and lymphocytes. When the root cells are destroyed and the lymphoid tissue is no longer formed then absorption of the devitalized tissue by the blood stream begins. As the absorption goes on foci come nearer the surface and finally the walls of the foci are broken down and the infecting focus is open to the surface. The roentgen-ray treatment is not directly bactericidal, hence after removal of the lymphoid tissue by the roentgen treatment there is applied concentrated ultraviolet light upon the surface of the infected area.

DONALDSON, MALCOLM. The treatment of inoperable cancer of the female pelvic organs. *Brit. M. J., Lond.*, Nov. 7, 1925, ii, 836–839.

Of the 46,000 people dying of cancer in England and Wales at least 5000 deaths are due to malignant disease of the female genital organs. This estimate is probably a low one. The importance of early diagnosis is stressed and should be broadcast as much as possible.

The time is not yet come when one can be dogmatic as to the exact technique for radiation therapy, but all recent work tends to suggest that the ideal to be aimed at is to distribute the radium as uniformly as possible throughout the growth and to expose the tissues for at least twenty-four hours, probably much longer. The author has not had any experience in the combined roentgen ray-radium treatment, but looks forward to promising results from this method. In all the inoperable cases of carcinoma of the uterus, radium treatment has resulted in a definite prolongation of life but there were no cures.

FABRY, JOH. Treatment of a severe roentgen burn of the hands with radium and doramad salve. *Med. Klinik*, Oct. 2, 1925, xxi, 1498.

A case is reported in a man aged sixty-four who had received roentgen treatment for chronic hyperkeratotic eczema of the hands. These treatments were given between 1917 and 1920. At the time of examination he was suffering from roentgen ulcer, dermatitis, and hyperkeratosis of both hands. The treatment consisted of baths for the hands with salves, radium treatment and doramad salve, together with mechanical removal of the hyperkeratoses. No statement is given as to the quantity of radium administered except that the small plaques were applied for several hours over the hands and that the doramad salve was applied for two to three days. Toward the end of the treatment the amount of doramad used was 2 gm. of 1000 units per gram to be applied for two days. The patient was considered completely cured by March, 1925. (Treatment was begun in December, 1924.)

FORSDIKE, SIDNEY. The treatment of inoperable cancer of the female pelvic organs. *Brit. M. J., Lond.*, Nov. 7, 1925, ii, 839–841.

There are definite contraindications to the radium treatment of advanced cancer of the cervix: (1) old pelvic infections may be awakened; (2) an infected growth may progress to massive necrosis with serious secondary hemorrhage; (3) cachectic cases have a very small margin of resistance and any additional onslaught may be fatal; (4) fistulae, secondary abdominal deposits and nerve root pain are absolute contraindications; (5) where the bladder and the uterus are involved, prospect of successful treatment is very low.

The author has treated 196 cases of cancer of the cervix; 100 inoperable cases by radium alone, many of which were in a hopeless state. Ten of these are still living, 3 free from recurrence for over four years, 3 free from recurrence for over three years, and 4 free from recurrence for over two years. There were 50 borderline cases, 25 of which became operable after one exposure to radium, and the Wertheim operation was performed.

In arguing that borderline cases should be treated by radium there is a real difficulty as to what to do about secondary deposits in the pelvic glands. The direct plan of opening the abdomen has strict limitations. There remains but one method and that is the combination of roentgen rays for the pelvic deposits, with radium for the local lesion.

Ninety per cent of the advanced cases are eligible for radium treatment; the remainder being debarred because of contraindications mentioned. A few of the cases treated by radium are cured clinically and remain well for period of two, three and four years. Life is prolonged for the majority of the cases from six to eighteen months, and all of them enjoy a degree of comfort which no other form of treatment offers them.

GALLINO, M. MIRANDA, and TERRADA, H. MALTER. Roentgen therapy of the spleen in asthma. *Semana med., Buenos Aires*, Sept. 3, 1925, xxxii, 584–587.

Dreg and Lossen in irradiating the spleen of a patient who had been asthmatic for sixteen years, for chronic lymphatic leucemia, found that the asthmatic attacks stopped with the irradiation. After this Lossen and Groedel reported two series of irradiations of the spleen for asthma, one of 30 cases and the other of 41. In the total of 71 cases they had disappearance of the asthmatic attacks in 38 per cent, great improvement in 16 per cent, in 21 per cent improvement characterized by decrease in intensity, frequency and duration of the attacks, in 10 per cent failure, and in 15 per cent the patients did not return after the first irradiation.

The authors treated 26 cases, excluding cases of symptomatic asthma and treating only those cases whose cause was unknown. They had total disappearance of the attacks in 12 cases, decrease of frequency, duration and intensity in 10, failure of treatment in 2, and the patients did not continue the treatment in 2. They irradiated a field 10 × 12 cm. over the spleen with a focus skin distance of 30 cm. and a tension of 200,000 volts, intensity 3 ma., filter 0.8 mm. copper and 2 mm. aluminum; individual dose half of a skin erythema dose; one to three irradiations at intervals of 30 days. They used very penetrating rays because they found that cases irradiated for leucemia in which splenectomy was performed later did not present the fibroplastic perisplenic process which was found in cases irradiated with less penetrating rays.

The mechanism of the action of the rays in these cases is not known. The authors assume that there is an endocrine-vegetative disequilibrium in every asthmatic which predisposes him to attacks and that the irradiation sets free hormones which tend to modify this latent endocrine fragility. In any case, with a record of 46 per cent of prolonged cures and 38 per cent of frank improvements the treatment is worth trying in idiopathic asthma.

GUARINI, C. The roentgen treatment of tumors of the brain. *Arch. d. radiol.*, July–Aug., 1925, i, 593–609.

Guarini gives the clinical details of 4 cases which he has treated with roentgen rays, 3 of tumors of the hypophysis and one of tumor of the hypophysis with involvement of the auditory nerve. These tumors are irradiated with very hard, penetrating rays of short wave length. He chooses a large number of small fields, as many as 10, 14 or even 16, 6 × 6 cm. in size. For localizing the bundle of rays on the hypophysis he uses Kriser's skull quadrant, which is illustrated. He uses four frontal fields, two on the right and two on the left, one which includes the base of the nose, four fronto-parietal ones, four temporal ones, and to these may be added zygomatic, submental and occipital fields. The anticathode skin distance is always 30 cm. He irradiates but one skin field a day, leaving an interval of some days between treatments. The repetition of the series depends on the results obtained; in general, a series should not be repeated in less than twelve to sixteen weeks.

The symptoms of tumor of the hypophysis, aside from gigantism and acromegaly are mostly ocular. There are changes in the visual fields, changes in the disc and ocular paralysis. The first symptom which improves on irradiation is the visual field, which begins to enlarge almost immediately, and then the decreased visual acuity begins to increase, even while the disc is still pale. The exophthalmos may disappear entirely, as well as the paralysis of the motor muscles and the diplopia. The rays have a beneficial effect on the genital disturbances; virility returns in man, and the menses become regular in woman. In the cases of gigantism and acromegaly there is arrest in the development of the disease and decrease

in size of the soft parts. The author concludes that roentgen therapy is to be preferred to radium therapy in these cases because the rays can be directed more accurately on the hypophysis. He concludes from his results in these cases and others that he still has under treatment that roentgen therapy is the treatment of choice in tumors of the hypophysis.

HAAS, LUDWIG. Radiation therapy of tuberculosis of the upper respiratory tract. *Med. Klinik*, Aug. 21, 1925, xxi, 1263–1264.

A report is given on an experience lasting more than eight years in the treatment of cases with light therapy combined with other methods. In the treatment of the upper respiratory tract the principal therapeutic aids are a combination of roentgen rays in small doses (or radium irradiation especially in cases with small, well limited, flat foci) with carbon arc light treatments.

The present report covers 42 cases of which 21 were cured, 16 improved, 3 stationary and one became worse. Of the 21 cured, 4 were treated either with roentgen rays or radium alone, 6 with carbon arc lamp and the remainder with a combination of the two. Of the 16 improved cases, 2 were treated with roentgen rays or radium, one with carbon arc light, and the remainder with a combination of the two methods. Thus it will be seen that the majority of the cases received the combined treatment.

The radiation of the larynx was performed as follows: With the roentgen tube above, radiation was administered to one field on the right and left sides of the neck. The period between the two treatments was four to eight days. The dose was practically always 5 Holzknecht units filtered through 4 mm. Al. In youthful patients, especially those whose general condition commanded caution, the dose was divided into two parts, namely, 3 and 2 Holzknecht units administered at intervals of four to eight days. Depending upon the strength of the local reaction taking place after treatment, a similar irradiation was administered three to five weeks later and repeated as a rule four to five times, with intervals of at least two months in between. The repetition of a series was made dependent upon the local condition. Disagreeable side reactions were never observed.

Summarizing these observations it may be stated that the best results have been obtained by the combined roentgen-ray-carbon arc irradiation in tuberculosis of the mucosa and the larynx, especially against cases which have shown themselves refractory to either roentgen treatment or carbon arc treatment alone. The roentgen treatment usually reduces the time of treatment considerably and is preferred by the patients.

HEYMAN, JAMES. The treatment of inoperable cancer of the female pelvic organs. *Brit. M. J., Lond.*, Nov. 7, 1925, ii, 827–831.

A report is given of cases treated radiologically at the Radiumhemmet, Stockholm, recurrences after operation not being included. In cases of cancer of the cervix of the uterus, primary radium treatment caused cessation of bleeding in nearly all the 375 cases of inoperable cancer observed between 1916 and 1922. In nearly two-thirds of the cases the vaginal discharge ceased and in over 50 per cent the pain disappeared. The freedom from symptoms in more than one-third of the cases lasted more than one year. Of 234 cases treated from 1914 to 1919, 39 or 17 per cent have remained healed for five years or more. Of the inoperable cases some have been cured for several years.

During the years 1915 to 1922 there have been 54 cases of cancer of the corpus uteri which were inoperable or technically operable but clinically inoperable. Of 17 such cases under observation for five years or more, 10 remain free from symptoms for five years. The two-year result for all the 54 cases shows 55.6 per cent free from symptoms. Of the inoperable cases after five years 4 out of 11 cases were cured by radium treatment.

The results of the treatment of inoperable cases of cancer of the ovaries are not good. Fifteen such cases were observed and none survived after four years. In the group comprising incompletely operated cases of carcinoma of the ovaries radium treatment produced more favorable results. After four years one-quarter of the 23 cases were free from symptoms, and after five years 21.4 per cent. The radium treatment should be given as soon as possible after operation.

Sixteen cases of cancer of the vagina have been treated with radium. One has been alive and free from symptoms for three years, another for four years and 2 for more than five years.

A rare form of tumor is carcinoma limited to the urethra and its nearest surroundings. Six such cases have been treated by means of roentgen rays, by radium and by emanation seeds. The most satisfactory results seem to have been observed with the emanation treatment. A total of 64 cases of cancer of the vulva have been treated from 1910 to 1924. All of these were far advanced, with great local tumors and palpable glands. Probably in a considerable per cent of the cases where a lasting cure has been obtained the condition was one of septic lymphadenitis and not of

cancer metastases. Early poor results with radium treatment in this group were probably due to defective technique. Improvement in the technique resulted in freedom from symptoms for two years or more in about 20 per cent of the cases. By first applying electrocoagulation to the tumor and then administering radium, pronounced palliative result has been gained. In more than half of these cases local freedom from symptoms has been obtained and the patients have been free from severe local troubles until death due to metastases. In all cases the regional glands were treated with roentgen rays.

There is scarcely ever a contraindication to the radium treatment of cancer of organs in the female pelvis. With careful dosing even a far advanced cancer in a very cachectic individual may be treated without injury to the patient.

HEYMAN, JAMES. Technique and results of the treatment of cervix carcinoma in Radiumhemmet, Stockholm. *Strablentberapie*, 1925, XX, 34–56.

In the treatment three irradiations with radium were given as a rule. The second irradiation followed a week after the first and the third weeks after the second. When possible, radium is applied both in the vagina and in the uterus at each treatment. The duration of a treatment is about twenty-two hours. The dose is 33.7 or 40.1 mg. element applied to the uterus three times, thus giving a total dose of from 2220 to 2640 mg-el-hr. In the vagina there is applied 70 mg. element three times, which is equal to a total dose of about 4500 mg-el-hr. The radium is always filtered through 3 to 4 mm. lead.

During the past three years a more concentrated treatment has been attempted by reducing the number of treatments to two and increasing the duration from twenty-four to thirty-two hours. In such cases the total vaginal dose was limited to 4000 mg-el-hr. Any operative procedure at the beginning of the treatment, such as cauterization or excochleation is absolutely contraindicated. The treatment is never to be repeated within the first six months. If the growth has not disappeared in six months after the administration of the three different irradiations or if a recurrence has taken place the treatment may be repeated; although such a repetition should preferably not be given before the lapse of a year. In repeating a treatment only one irradiation is given.

Clinically cured cases, as well as cases with a suspected "reactive" inflammation, are preferably not to be treated again unless a recurrence has been definitely established. If the recurrence is purely local and the tumor is operable the uterus should be extirpated. When, however, extensive gland metastases occur roentgen irradiation in conjunction with radium treatment is applied. The roentgen therapy should be given even though severe pains remain from the radium treatment, and when a recurrence takes place in the parametrium. Massive doses are not applied. Each field receives two or three treatments of about one-half to one-third of an erythema dose filtered through 0.5 mm. Cu, spark gap 38 cm., focal skin distance 23 to 30 cm.

The experience with this treatment covers 505 cases of cervix carcinoma during the period 1914 to 1921. From 1914 to 1918, 91.2 per cent of the cases were inoperable or borderline cases; from 1919 to 1921 these cases averaged 68.4 per cent. One-third of the patients were under forty-six years of age and 19.1 per cent were forty years or less.

The results show 20.3 per cent of all the cases treated from 1914 to 1918 to be free from all symptoms after five years. The above average includes two poor years (1916 and 1917) when the percentage cures were very low, probably owing to inadequate treatment. The results in the operable or borderline cases during the period 1914 to 1918 show 40.5 per cent free from symptoms after five years. The corresponding group treated in 1919 showed 47.3 per cent free from symptoms after four years; the 1920 group 60 per cent free from symptoms for three years; and the 1921 group 58.3 per cent free from symptoms for two years.

Among the inoperable cases for the period 1914 to 1918, 16.6 per cent have remained free from symptoms for five years. Of the rest 20 to 25 per cent remained free of symptoms for three years.

Local recurrence, if it occurs, appears as a rule in a year. Gland recidives and metastases may appear unsuspected after years of apparent good health. Pains, anemia and fever indicate practically always the presence of cancer in the pelvis.

The complications as a result of radium irradiation are mainly in the rectum, and appear as a rule six months after treatment. These complications are due to overdosage and are characterized by tenesmus and hemorrhage. Since 1915 there has not developed a case of fistula. Five cases died of diffuse peritonitis and sepsis as a result of treatment, and there was one death from pulmonary embolus. The primary mortality assignable to radium treatment is about 1.19 per cent.

KENNEDY, WILLIAM H. Present status of radium in the treatment of uterine hemorrhage. *Indianapolis M. J.*, February, 1925, xxviii, 34–36.

Wherever it is possible to effect cessation of the hemorrhage by directly treating the condition responsible for this alarming symptom such a procedure should be instituted without delay. Radium treatment is still not as frequently applied as the results would justify. One reason for this state of affairs is the fact that much of the literature on this subject is found only in specialized journals and consequently does not reach the physician who should be most concerned and to whom the patient has come for relief.

Radium treatment should be the method of choice in uterine hemorrhage with a few exceptions, one of these being cancer of the body of the uterus. The author has treated 43 cases of myopathic hemorrhage in girls between the ages of eighteen and twenty-five years, without impairment of the reproductive functions. In only 3 of these cases was it necessary to repeat the treatment and one case required a third treatment. The dosage ranged from 600 to 1200 mg-radium-hr.

In the therapy of fibrosis of the uterus radium has presented another evidence of its worth. In one case the author was surprised to obtain disappearance of the tumor the size of a cabbage, but this procedure is not advised as a regular thing. In treating malignancy of the cervix, results with radium have proved most encouraging.

A growing experience indicates that the radium treatment can almost certainly produce a cure in every case of functional, essential, or idiopathic uterine hemorrhage occurring either at puberty or menopause. Although radium seems more applicable to women at or near the menopause, it will be found to be almost a specific for the younger patients as well when sufficient care and judgment are exercised in regard to dosage and screening.

KRAUS, FRITZ. Roentgen treatment of peripheral paralyses. *Med. Klinik*, Nov. 20, 1925, xxi, 1768–1771.

Experiments for the past two years upon rabbits have shown that peripheral paralyses produced surgically were influenced by physical therapy in the sense that motility returned sooner and the muscles recovered more promptly than in untreated animals.

Cases are cited of the roentgen treatment of traumatic paralyses of the peroneal nerve, sciatic nerve, femoral nerve, the branchial plexus, and 2 cases of acute anterior poliomyelitis. These comprise 16 cases of peripheral paralysis and 2 of central which have been treated during the past three years by roentgen therapy supported by the customary physical procedures. The results show 13 recoveries and 5 improvements. The roentgen treatment consisted of 3 to 5 H, filtered through 4 mm. Al. Rather pronounced effects are obtained with these small doses and when carefully applied they are without danger to the patient. There was a distinct reaction phase following the first irradiation, after which there occurred a negative phase, which was succeeded by recovery of function.

The results indicate that roentgen therapy is one of the best and quickest methods for inducing clinical recovery from these paralyss.

LAHM, W. The result of radiation treatment, as measured in R units, upon collum carcinoma in the so-called critical zones. *Strahlentherapie*, 1925, xx, 1–33.

The experience of the author shows that administered radiation can be calculated in terms of R units and dosed accordingly, but that in addition this procedure permits for the first time a precision in radiation treatment which is so necessary. The value of 600 R recommended by Martius as the average useful erythema dose has turned out in practice to be so well fixed as to assume the importance of an absolute value. The Martius value finds confirmation in the general experience both with roentgen treatment and radium treatment of carcinomas. There is altogether too much unreliability in estimating the erythema dose by the visual appearance of the skin. The erythema dose in nine clinics in Germany varies all the way from 285 R to 1120 R.

Not only are roentgen rays standardized in terms of R units, but radiation from radium can be likewise standardized. With preparations of medium content the erythema dose lies near 450 mg-element-hr. per centimeter. Radium values may be transformed into R units by multiplying the erythema dose by $\frac{4}{3}$. For instance, 330 mg-el-hr. per centimeter (the isodynamic value of the erythema dose) equals 440 R.

The experience in the Dresden Clinic from January 1, 1918 to April 1, 1925 concerns itself with the treatment of collum carcinoma in two general groups. From 1918 until early 1921 the treatment was entirely by radium, and the results could be correlated with the dose in terms of R units by a mere calculation from the case reports. The second group comprised cases receiving combined radium and roentgen treatment. The total number of radium cases was

218, of whom 34 are considered cured for the five-year period. When these cured cases are subdivided according to the severity of the symptoms and according to the dose of radiation administered at the critical zone of the tumor the striking fact becomes apparent that the great majority of cures were obtained with doses from 1000 to 2750 R; while doses from 3000 to 10,000 R were credited with only few cures. The above optimum values at the critical zone of growth correspond to somewhat less than 13,000 mg-el-hr. per centimeter radiation in the central portion of the cervical canal. This is the absolute upper limit for the radium dose.

Of the cases treated by combination of radium and roentgen rays there were 112 who received one treatment and 69, two or more treatments. The reports for the past three years show 42 recovered or temporarily healed; 61 dead; 13 belong to Group IV (palliations) and the remainder lost track of. The results correspond with the findings in the group treated by radium alone.

The calculation of radiation dose in terms of R units not only determines uniformity in dosage but gives also valuable indications for practical radiation therapy. The critical parametrium dose is about 2750 R for cases in Group I and II and about 2000 R for cases in Group III. If one desires to proceed exactly it is necessary to keep within the limit of sensitiveness of the rectum which is about 1920 R. Collum carcinoma can best be treated by a combination of radium and roentgen rays with special precaution to avoid all local injury by the radium. Collum carcinomas of Group I and II should receive a maximum dose of 6000 to 6500 mg-el-hr. per cm. of radium, but the roentgen dose must be so adjusted that 2750 R at the critical zone is not exceeded. Fractional irradiation is probably not absolutely necessary.

Collum carcinomas of Group III should receive radium administered with greatest caution; doses of 1000 to 2000 mg-el-hr. per cm. suffice in case of need. This first dose of radium is completed with roentgen rays up to about 700 R, followed later on by 600 to 750 R. It is still a question whether a lower dose, about 500 R, may not be enough. Recidives following radium treatment have been repeatedly cured by a roentgen treatment. A certain non-homogeneity of the rays coming from the centrally located radium appears to be valuable but the dose at the critical zone should always be watched.

The details of therapeutic procedure are outlined and five brief case reports are given of women treated with radium.

MESTSCHANSKI, J. Thymus-thyroid irradiation in psoriasis. *Deutsche med. Wchnschr.*, Nov. 6, 1925, li, 1874.

Preliminary experiments showed that unfiltered rays applied mainly to the thymus and both lobes of the thyroid in the form of small stimulative doses (2 to 3 X), produced spontaneous recovery in the majority of children with psoriasis after one or two treatments. It was observed, however, that in adults with this disease such stimulative doses were inadequate although the conditions became no worse. As a result the rays were filtered through 0.5 to 1.0 mm. Al and it was found that no improvement or recovery resulted, while in one case there was a distinct extension of the psoriasis. Systematic investigations showed that the correct dose was 5 X through 3 mm. Al, given at intervals of four weeks. Very frequently there is considerable complaint of itching after the first treatment, and quite often there is a slight awakening of the residual efflorescences after the second or third treatment. There was, however, a very striking improvement in the condition with disappearance of the scalp desquamations. The technique of irradiation is as follows: The patient lies upon his back with the neck supported by a sandbag, with the head projecting beyond the bag. The surface to be irradiated is thereby presented in a flat plane and the selected areas may be marked out. These extend from the thyroid cartilage down to the lower portion of the manubrium sterni and about 5 to 6 cm. on each side of the central line. The head is inclosed in a box protected with leaded rubber. The neck piece is laid over the thyroid cartilage and the tube is held at 22 to 23 cm. focal skin distance from the area to be exposed, with 3 mm. aluminum filter interposed. The dose given is 5 X which is repeated after an interval of four to five weeks. In addition the patients are advised to take sulphur baths once or twice a week and to use local treatment for relief of the itching and for softening the skin.

There were a total of 41 cases of psoriasis treated with roentgen rays as above. In more than half of the cases the condition was relieved, often after the first eight to fourteen days; and in the remaining cases there was a distinct improvement. Only a very small fraction of the cases remained completely resistant to the roentgen therapy. Recidives were not infrequent and occurred from two months to two years after the last irradiation.

So far as can be judged from present observations it would appear that psoriasis is in some way associated with a constitutional anomaly, but that some parasitic organism is necessary to initiate the symptoms.

MÖBIUS, HANS. Ten years' radium treatment in skin diseases. *Med. Klinik.* June 26, 1925, xxi, 967–970.

The experience of the author in a variety of obstinate skin conditions has shown that radium is an invaluable aid. With the use of stronger preparations still better results should be obtained than in the past. Radium may be unconditionally recommended (1) in the treatment of all forms of lupus, (2) in skin carcinomas, with certain limitations; (3) in keloids, and (4) in nevi. In Dupuytren's contracture radium can be recommended only with reservation; in induratio penis plastica radium is contraindicated. In certain forms of eczema and sycosis simplex treatment by wiping or rolling over the surface with radium has been found effective. Large areas of the skin thus affected were conveniently treated and the symptoms quickly controlled.

MÜLLER, A. Roentgen therapy of bronchial asthma. *Med. Klinik*, Oct. 2, 1925, xxi, 1493–1495.

Since August, 1924, the roentgen division of the Rostock University Medical Clinic has been treating bronchial asthma systematically with roentgen rays, the treatment consisting of a combined irradiation of the spleen and the root of the lungs. Cases that have proven refractory to a mere irradiation of the root of the lung have responded after one or two treatments of the spleen. The procedure in all severe cases is to irradiate the spleen and the lung root in such a manner that in the course of five to six days one-shird of a skin unit dose is applied to the skin upon the sternum and the back as fast as the constitutional symptoms of roentgen catarrh have receded. These treatments are repeated in a period of three weeks; and three to four such series are required on the average before a distinct improvement or recovery is obtained. The roentgen rays were delivered with a Symmetrie apparatus and Müller S. H. S. tubes, 2 ma., 124 sklerometer, 23 cm. focal skin distance, 3 mm. Al, field 6 × 8 cm, 220 volts. Some typical cases are cited.

Since this treatment has been instituted 22 patients have been observed; of these 27.4 per cent have been extraordinarily improved or healed; 50 per cent have been bettered; 4.5 per cent remain unimproved, and 18.1 per cent were lost sight of. In evaluating the roentgen treatment it is necessary to distinguish between genuine bronchial asthma and the psychogenic type. The latter are often influenced by suggestion but this suggestion therapy is of no avail in true asthma as was found in a few of the author's cases. Several of these were put through the motions of a roentgen treatment but with the interposition of a lead screen and they returned with the complaint that no improvement had been obtained by the last treatment.

How the roentgen rays produce their effect is still a puzzle. A case is cited in which irradiation of distant portions of the body have produced pronounced improvement in bronchial asthma.

PALVARINI, ALDO. Radium therapy. *Radiol. med.*, October, 1925, xii, 709–711.

The use of radium is being extended at the hospital in Paris where Palvarini works, as a result of their having obtained a larger amount of radium due to the activity of the League against cancer.

They use Regaud's epidermicide dose which is almost double the erythema dose; it can be obtained by doubling the amount of radium or the time of application necessary for an erythema dose; such a dose is justifiable in the treatment of malignant tumors. A filter equivalent to 2 mm. platinum is used; such a high filtration in addition to decreasing the difference between the superficial and deep dose gives primary rays, and consequently also secondary electronic rays, which are more elective. The distance is proportional to the quantity of radium used, the filtration and duration of the treatment; the radioactive source may be as much as 3–4 cm. from the skin or in exceptional cases as much as 10 cm. Crossfire may be brought about by the usual curved apparatus; they use a standard provided with 3 radium containers arranged around the arc of a circle at a distance of 10 cm. from each other and 10 cm. from the skin, with the bundles of rays arranged in such a way that the crossing takes place beneath the skin (Mallet). With regard to the distribution of the rays, Mallet's studies of isodose curves have established the best distribution (multiplicity of radioactive foci, optinum length of tube, distance between them, their arrangement in parallel lines) with reference to both superficial and deep doses. The consequent better utilization of the rays furthers economy in treatment. Distribution of the dose over six to eight days at least, or up to four weeks at most makes it possible to obtain in twenty days an effect with $\frac{1}{10}$ of the amount of radium that would be necessary to obtain that effect in two days.

The author advocates the study and application of the mobile system of Cappelli and the use of Mallet's ionomicrometer.

PIRIE, A. HOWARD. A résumé of the therapeutic value of *x*-rays. *Canad. M. Ass. J.*, January, 1926, xvi, 54–56.

A brief paragraph is given to each of the following conditions with the indications or contraindications for roentgen therapy: Ring worm, favus, chronic boils, hyperidrosis, psoriasis, keloid, warts, rodent ulcer, lupus vulgaris, acne vulgaris, eczema, superfluous hairs, nevus, uterine fibroids, uterine hemorrhage, enlarged thymus, exophthalmic goiter, tuberculous glands, splenic lucemia, lymphadenoma, and carcinoma. The dosage is given in terms of the Sabouraud epilation dose.

PORDES, FRITZ. The radiation treatment of gynecological carcinoma. *Münchcn. med. Wchnschr.*, Apr. 17, 1925, lxxii, 653.

This is a comment on a paper of the above title by Scholten and Voltz. These authors quote the law of Bergonié and Tribondeau stating that a cell type is more sensitive to irradiation, the more labile the energy relations of the cell and is less sensitive the more stable these energy relations. Pordes calls attention to the fact that this is not the law of Bergonié and Tribondeau; the concept of labile and stable conditions of the cell types was introduced by Pordes as an explanation of the effect and is in no way an explanation of the Bergonié-Tribondeau law. What is to be understood by "stable energy relations" is not very clear. The assumption of a parallelism between stability-lability and resistance-sensitiveness appears to clarify the phenomenon. The differences between this view and the Bergonié-Tribondeau rule are to be discussed in a forthcoming paper.

PRUSCIANO, F. Roentgen treatment of Basedow's disease. *Arch. di radiol.*, July–Aug., 1925, i, 633–638.

It is impossible to give a routine technique of treatment in this disease as it must be adapted to the clinical pictures. The author gives brief notes of treatment and results in his 29 cases.

CASE 1. Woman of forty-five; for about fifteen years enlargement of the thyroid with development of Basedow symptoms after a violent moral shock. Weakness, tremor, tachycardia, enlarged heart, headache, insomnia, emaciation. No ocular symptoms. Irradiation given from two lateral fields, 22 cm. spark gap, filter 6 mm. aluminum, focal skin distance 23 cm., dose 1.4 erythema dose. After five days, irradiation of an anterior field 8 × 8 cm. including the front of the neck and the upper part of the sternal region. The patient felt calmer, the pulse was less rapid and there was less palpitation. After eight days the treatment was given again and was continued for about four months with progressive improvement. The improvement continued for three months when she was given thyroidin by her family physician and the symptoms began again worse than ever. On renewed treatment with very hard rays she improved again until the symptoms were slight.

CASE 2. Woman aged twenty-one, who after a psychic trauma commenced to suffer from tachycardia and tremor; enlargement of the left lobe of the thyroid, insomnia, headache, sweating, emaciation, excitement on the slightest emotion; no eye symptoms. Roentgenotherapy with 4 mm. Al filter, 20 cm. spark gap; rapid improvement; decreased rapidity of pulse and lowered blood pressure; nervous excitement quieted. The treatment continued with periodical irradiations for three months and the patient was greatly improved so she stopped treatment.

CASE 3. Genuine Basedow in a woman of thirty-five, with large thyroid tumor, marked exophthalmos, tachycardia, tremor, alimentary glycosuria negative. Roentgen therapy, spark gap 12 cm., filter 4 mm. Al, anterior and lateral fields; brilliant results; in three months no symptoms, in six months bulbar protrusion almost disappeared, thyroid reduced.

CASE 4. Basedow fruste. Patient of forty-five; for about two years diffuse enlargement of the thyroid. For six months emaciation, psychic depression, signs of manic-depressive insanity, slight tremor, glycosuria. Roentgen therapy, rays 30 cm. after trying longer waves, gave slight improvement. The treatment was stopped in four months.

CASES 5, 6, 8, 11, 13, 17, 20, 24, 25, and 26. Genuine Basedow in young patients, 7 females, 3 members of the same family. The syndrome was complete in all the cases. Roentgen treatment for three to eight months gave enormous improvement. The protrusion of the eyeballs was not completely cured in any of the cases; improvement in the ocular symptoms was slow.

CASES 7, 9, 10, 12, 14, 15, 16, 18. Group of formes frustes, 5 of which were improved and 3 not improved.

CASE 19. Spurious form accompanied by sclerodermia. Irradiation with 20 cm. spark gap, filter 0.5 Al, ¼ erythema dose every eight days. Considerable improvement in which the sclerodermia participated.

CASES 21, 22, 27. Genuine Basedow with marvelously rapid improvement in a month

and a half of treatment. These cases are recent and it is impossible to tell the ultimate results.

Case 23. A large goiter on which radiotherapy had no effect; developed a hyperfunction and afterward a hypofunction of the thyroid. Advises abstention in diffuse and adenomatous goiters.

Cases 28 and 29 were cystic goiters.

Rocchi, G. Radium therapy. Beta therapy. Effect of a magnetic field on the direction of beta radiation. Distant field in deep gamma therapy. *Radiol. med.*, November, 1925, xii, 762–763.

Beta therapy is the use in radiotherapy of corpuscular radiations with a negative electrical charge to exercise an injurious action on cells. It may be practised either with the primary beta rays of radium, secondary beta rays which develop in the tissues on roentgen irradiation, or secondary beta rays which develop from metallic corpuscles introduced into the tissues by electrolysis and acted upon by roentgen or radium rays. In this connection Mme. Curie has recently brought out a new fact, namely, that there is a radioactive body, uranium X, which has a life of about twenty-six days and which can be isolated and used in beta therapy, giving a large amount of pure radiation of corpuscular beta rays which are hard.

Rocchi has found that if radium is placed in a thick lead casket and the casket set on a photographic plate no impression is made on the plate, provided the lead is thick enough to intercept the radium rays. But if an electric field is established with an electromagnet an impression is produced to the right of the casket by the corpuscular beta rays of the radium which are deviated to the right by the magnetic field. He suggests that this fact may be utilized in directing beta radium rays to a lesion to be treated.

If Domenici radium tubes with strong filtration are fixed to the closed extremity of a quadrangular lead tube 4 cm. on each side with walls 2 cm. thick and 9 cm. from the base to the opening, it gives a source of pure hard gamma rays with which a cross fire treatment of a deep tumor may be given as with roentgen therapy, but it has the advantage over the latter in that gamma radiation is being used and it may be continued for thirty to forty days. But it has the disadvantage of being very expensive as it requires a large amount of radium to give a sufficient deep dose. Radium therapy is at present the most rational treatment for epithelial cancer; roentgen therapy is being reserved more and more for sarcoma.

Röver, F. The roentgen treatment of pulmonary tuberculosis. *Münchn. med. Wchnschr.*, May 15, 1925, lxxii, 801–802.

The author reports upon an experience with 70 cases irradiated during 1921 and 1922. These were patients with pulmonary tuberculosis, who were capable of going about their occupation and could be treated in an ambulant clinic. These cases received no other treatment besides the roentgen therapy. There were 7 deaths, mostly amongst patients seventeen to twenty years old. These were cases of progressive exudative pulmonary tuberculosis in somewhat advanced stage. Of the remainder, 44 were re-examined and 7 of these showed no improvement whatever; 5 were in fairly good condition; 14 were distinctly improved, and 18 were very much improved. In 20 of the cases the average gain in weight was 4 kilos. There was a decrease or disappearance of the cough or sputum and of night sweats.

Roentgen examinations were made before and after the roentgen therapy and it was observed that there was no change in cases suffering from productive tuberculosis. In some there was a suggestion of accentuation in the lung markings. It was demonstrated in all cases that no new shadows had appeared in the interval of two to three years since the last roentgen treatment. These findings, taken in conjunction with the general improvement in the clinical condition and the increase in weight demonstrate conclusively that the productive form of pulmonary tuberculosis can be very actively attacked with roentgen rays. The roentgen treatment was given in one, two or three series about six months apart (no statement of the factors is given).

Rütz, A. Clinical and histological results following roentgen irradiation of subacute and chronic sweat gland abscesses of the axilla. *Med. Klinik*, Aug. 28, 1925, xxi, 1299–1301.

An experience with about 60 cases of acute, subacute and chronic abscesses treated by a combination of surgery and roentgen therapy indicates this procedure to be the method of choice. All these cases have been re-examined fifteen months after treatment and found to be free of recurrences. There were no signs of roentgen injury even in cases receiving the so-called obliterating dose (one skin unit). Four of the cases show slight pigmentation of the axillary skin and one complained of occasional itching in the irradiated axilla. There were no contractures due to scarring in any of the cases. The cosmetic results are in general excellent.

The treatment in a chronic recurrent case was somewhat as follows: In order to follow the histological changes small pieces of tissue were removed at regular intervals. Slight operations were performed to open the pus pockets and on the same day the application of divided obliterating dose was begun (one skin unit dose in two to three sittings). These sittings usually occurred on successive days, except where a pronounced reaction occurred, when the intervals were longer. On the next day the skin of the axilla shows pronounced inflammatory edema and the operation wounds secrete a seropurulent fluid. The solitary foci which on the previous day had shown a firm consistency, extend outward somewhat and on comparison with the surrounding skin possess a slight livid discoloration and do not feel as hard as on the day before. On the third and fourth day after the application of the skin unit dose the edema of the axillary skin is found to have increased. There is a bright reddening of the skin; in place of the infiltrated foci one sees dark bluish-red prominences from the size of a hazelnut to a cherry, and having an elastic consistency. These structures show no fluctuation. For the sake of experiment some of these foci were incised. They gave the impression as if one were cutting into a juicy fruit of firmly elastic consistency. In most cases these emptied out a bloody serous fluid (edema) and only very rarely some pus. On the fifth to the seventh day one observes at several points the formation of new structures of the same kind; the others have become flatter, gradually losing their bluish-red discoloration, their consistency is no longer tensely elastic but firm and indurated. From the eighth to the fourteenth day all the foci gradually recede without incision. In some cases where as a result of irradiation there has been a confluence of several small foci incision is performed. Only rarely is an abscess found in such cases. Instead there is a fixed edematous infiltration. The most obstinate cases are cured in the course of sixteen to twenty days.

The histological studies fit in with the clinical facts. The roentgen irradiation elicits an acceleration of the inflammatory reaction which has a curative effect. Microscopically there was found a hyperplasia of the connective tissue which caused an acceleration of the organization of the pyogenically infected tissue. After the application of the so-called obliterating dose (one skin unit dose) no atrophy was observed histologically in the sweat glands. Nevertheless the clinical result indicated an obliteration which must have been of a biological nature.

SCHEMPP, ERICH. Radium treatment of esophageal carcinoma. *München. med. Wchnschr.*, Apr. 17, 1925, lxxii, 648–649.

So far as concerns permanency of results the radiation treatment of carcinoma of the esophagus has not fulfilled expectations. Permanent cure confirmed by histological studies has been only rarely reported. Unfortunately surgical treatment offers little hope because most of the patients appear for treatment when in a very much reduced condition. These have to be treated with radium and roentgen rays to secure subjective relief. The results in the surgical clinic of Tübingen were much better after combined roentgen-radium treatment than they were with roentgen rays alone. The average survival after roentgen therapy was about four months, whereas with radium alone or combined roentgen-radium treatment it was over six months. These generally poor results are blamed in particular upon post-war conditions. For effective radium treatment it is absolutely necessary to be certain that the tube containing the radium is definitely in contact with the carcinomatous stenosis, otherwise there is danger of severely damaging the esophageal wall without even touching the tumor. In a method suggested by the author a section 7 to 10 cm. long of the vesical end of a Pezzer catheter is used as the container of the radium tube. This catheter serves both as a filter and a prothesis. The upper end is connected with a thread reaching through the mouth and this upper end is bulged out laterally so as to serve as a conical stop over the stenosis. The lower end of the catheter contains an oval metal point. The upper stop prevents the radium holder from slipping down below the stenosis.

SCHUMACHER, PAUL. Present status of roentgen therapy and roentgen diagnosis in gynecology and obstetrics. *Klin. Wchnschr.*, Nov. 5, 1925, iv, 2160–2166.

One of the most important and well-known direct irradiations of the female genital organs is the treatment of the ovaries for purposes of "castration." The best form of such treatment is the application of two abdominal and two sacral fields over each ovary, the total dose over each field being 35 per cent of the skin unit dose. In younger women it may often be necessary for controlling severe ovarian hemorrhages to produce a unilateral roentgen castration. The aim of this method is to call forth a normal menstruation and avoid possibility of an amenorrhea. A correct differential diagnosis is always necessary. Frequently there are almost insurmountable difficulties in determining

which ovary is to be irradiated. In well-selected cases successful results may be expected in 50 per cent, but it is recommended that this method be practised conservatively.

Intrauterine radium radiation is perferred in cases where temporary arrest of hemorrhage is required. The radium rays produce their primary effect by destruction of the bleeding mucosa and only very slightly by action on the ovaries.

For the successful treatment of myomas an exact diagnosis is of especial importance. Experience shows that sarcomas are especially sensitive to radiation and as a rule recede even with a dose of 60 to 70 per cent of the skin unit dose. The author does not agree that every uterine sarcoma should be irradiated and operation discarded. Such sarcomas are to be irradiated only in cases where there is a contraindication to operation or where the patient refuses operation.

It is the author's belief that irradiations of the uterus during pregnancy may produce serious results and it is recommended that if any radiation has been applied by mistake to a pregnant woman the pregnancy should be artificially interrupted because of the possibility that the child will be subject to severe disturbances of the bone growth as well as of the central nervous system. Attempts to treat osteomalacia by roentgen castration have yielded about the same results as operative castration. If osteomalacia occurs during pregnancy roentgen treatment should be avoided and such cases should be operated on. The use of roentgen castration in control of pathological sexuality or for eugenic reasons should be done only exceptionally and with the greatest of caution. Dysmenorrhea is stated to be an indication for roentgen castration. This should be done only exceptionally and in very severe cases in women approaching the end of the procreative period.

Uterus carcinoma is, next to castration, one of the most frequent conditions coming before the gynecological roentgenologist. The results of roentgen therapy have not been altogether satisfactory. A portion of the cases remain refractory despite the most exact technique of administration. It is the author's practice to operate upon every operable carcinoma and follow with postoperative irradiation in all cases. In treatment of carcinoma of the cervix or the portio it was a former belief that nonoperative treatment by roentgen and radium rays would be preferable through avoidance of the primary operative mortality; but the roentgen-radium treatment has not yielded any better permanent results. By a correct selection of cases and effective radical operation in the hands of a good surgeon the end result produced is far better than that by radiation therapy.

Vaginal carcinomas are not operated on but treated by radiation, and carcinoma of the vulva is radically treated by thermocautery followed by an intensive irradiation.

An important field for roentgen deep therapy is peritoneal and urogenital tuberculosis. The whole abdomen receives in two large distant fields light doses of 20 e (12.5 per cent skin unit dose). This roentgen treatment is not contraindicated even in the febrile stage of peritoneal tuberculosis. In genital tuberculosis the same mild dose of 12.5 per cent skin unit dose is applied. The curative effect of roentgen rays in tuberculosis seems to be produced by a stimulation in growth of the tuberculous granulation tissue and upon a general activating effect upon the whole body. There certainly does not seem to be any direct sterilizing action upon the tubercle bacillus itself. Noteworthy results are also obtained in tuberculous kidney and bladder with careful dosage of roentgen rays.

Pruritus vulvae may be cured by one-third skin unit dose through 3 mm. Al repeated every three weeks. Other forms of chronic eczemas seem to respond in a similar manner. Roentgen treatment is recommended for condyloma acuminatum of large size. The direction of the beam of roentgen rays should be so selected as not to produce injury of the ovaries. The dose should be one skin unit filtered through 0.25 mm. Zn, administered once or twice, with intervals of four to six weeks.

Progress of the past few years has made it possible to make successful use of roentgen diagnosis in gynecology and obstetrics. It is now possible to obtain clear and distinct pictures of the fetal skeleton in pregnant women. The roentgenogram gives information regarding the position and presentation of the fetus and its relations to the pelvic structures. Deviations from the normal, twins, hydrocephalus, etc., can now be directly observed and diagnosed. Serial roentgenograms make it possible to study the processes during birth, and normal and pathological parturition can be subjected to careful study. Pneumoperitoneum permits a roentgenological study of the non-pregnant uterus and other pelvic organs.

SUBJECT INDEX TO VOLUME XV

(abs) = Abstract. (E) = Editorial. (B.R.) = Book Review

Abscess, lung, study of 22 cases (abs), 472
Sweat gland, roentgen treatment of (abs), 588
Acne, treatment of, by combined use of roentgen ray and quartz light (ab), 393
Adenitis, cervical, condition of upper respiratory tract following roentgen treatment of (abs), 390
Cervical tuberculous, radiotherapy in treatment of (abs), 269
Adenomata, hypophysial (abs), 291
Air bubbles in interior of skull (abs), 471
Albers-Schönberg's disease (abs), 463
Allergy: Asthma, Hay Fever, Urticaria and Allied Manifestations (B.R.), 179
Amebic infection of colon, value of roentgen ray in estimating extent of (abs), 189
Amenorrhea, artificial temporary, in treatment of inflammatory diseases of uterine adnexa (abs), 385
American Annual of Photography (B.R.), 454
American College of Radiology, new officers of, 450
American Medical Association, program of 1926 meeting, 253
American Medical Association, Section on Radiology, 450
American Radium Society, new officers of, 450
American Roentgen Ray Society, announcement of annual meeting, 164
American Roentgen Ray Society, annual meeting (E), 546
Anemia, Biermer's, roentgen study of gastric function in (abs), 574
Aneurysms of the internal carotid and the circle of Willis, 122
Angioma cavernosum, a case treated by radium (abs), 477
Appendix, in normal subjects (abs), 572
Applicator, radium, for treatment of uterine carcinoma, 365
Arthritis, chronic, of hip (abs), 460
Deformans, juvenile (abs), 560
Tuberculous, changes in the articular surfaces in (abs), 379
Arthrogryposis multiplex congenita (abs), 266
Ascarides of small intestine, case discovered by roentgen examination (abs), 578
Ascaris, eggs of, coefficient of temperature of the action of the roentgen rays on (abs), 291
Asthma, bronchial, and chronic bronchitis, roentgen-ray treatment in (abs), 385
Bronchial, irradiation of spleen in (abs), 90
Bronchial, roentgen therapy of (abs), 586
Roentgen therapy of spleen in (abs), 581
Atelectasis of the lung (abs), 573
Atlas der Anatomie des menschlichen Körpers im Röntgenbild, by Albert Hasselwander (B.R.), 367
Atlas, manipulative (chiropractic) dislocations of (abs), 369
Autoblood and roentgen treatment, effects and rationale of (abs), 276
Autoradiography and fixation of polonium (abs), 294
Axilla, roentgen treatment of sweat gland abscesses of (abs), 588

Barium preparations, poisoning with, in roentgen studies (abs), 276
Salts, two deaths from administration of (abs), 281
Basedow's disease, roentgen treatment of (abs), 587
Biermer's anemia, roentgen study of gastric function in (abs), 574
Biochemistry of irradiation (abs), 279; 280; 489
Biological action of roentgen rays (abs), 280
Effects of radium upon tissues growing *in vitro*, 155
Reactions of growing tissues to radiant energy (abs), 274
Blood changes in rabbits and guinea pigs produced by local or intravenous injections of radium emanation (abs), 293
Coagulability, roentgen irradiation of spleen and (abs), 192
Human, studies on suspension stability of (abs), 286
Pressure, changes in, after irradiation of testicles (abs), 192
Pressure reducing effect of radium baths and radium emanation (abs), 490
Reaction, alkali reserve and mineral composition, influence of heat radiation on (abs), 489
Shift during deep irradiation (abs), 489
Bone diseases, juvenile, 357
Sarcoma, diagnosis and prognosis of (abs), 376
Bones, development of, after irradiation of testicles with roentgen rays (abs), 489
Of lower limb, congenital defects of (abs), 282
Brain, tumors of, changes in size and relations of lateral ventricles in (abs), 182
Tumors, roentgen-ray treatment of (abs), 269; 581
Breast carcinoma, present status of radiation therapy of (abs), 478
Carcinoma, roentgen treatment of (abs), 479
Carcinoma, spinal metastasis from (abs), 482
Recurrent carcinoma of, with roentgen-ray fibrosis (abs), 393
Bronchi, normal and diseased, lipiodol for study of (abs), 265
And trachea, roentgenographic demonstration of, 227
Bronchial dilatation with sinistrocardia and deviation of trachea (abs), 459
Bronchial stenosis, roentgen diagnosis of (abs), 578
Bronchiectasis, diagnosis of, with contrast oil (abs), 265
Roentgen-ray study of, 54
Bronchography aided by laryngeal catheter (abs), 573
Broncho-mycosis, treatment of, by roentgen ray (abs), 387
Bronchopulmonary lesions including tuberculosis, lipiodol as aid in diagnosis of (abs), 368
Bursitis, subacromial, calcareous deposits of (abs), 84

Calculus, urinary bilateral (abs), 461
Callositas and verruca plantaris, roentgen treatment of, and remarks on pathogenesis (abs), 388
Calvé-Legg-Perthes' disease (see osteochondritis deformans juvenilis coxae)
Cancer, advanced, roentgen treatment of (abs), 388
Immunity in (abs), 394
Inoperable, of female pelvic organs (abs), 482; 580; 582
Its cure (abs), 396
Mortality in the ten original registration states; trend for period 1910–1920 (abs), 287
Of the breast, radiation in treatment of (abs), 391
Of ear, nose and throat, electrocoagulation and radiation therapy in (abs), 391
Of lower lip (abs), 389
Of rectum, radiation treatment of (abs), 388
Of the tongue and oral cavity, treatment of, by radium emanation, 204
Of the tongue, results after treatment by radium and roentgen rays, 207
Radiosensitiveness of, in relation to cytodieresis (abs), 491

Cancer, radium in treatment of (abs), 89
Review of theories of mechanism of action of radiation in treatment of (abs), 274
Cancerous individuals, irradiation of endocrine glands in (abs), 87
Carbuncles, non-surgical treatment of (abs), 383
Roentgen-ray treatment of (abs), 387
Carcinoma, collum, radiation treatment of (abs), 584
Gynecological, radiation treatment of (abs), 190; 587
Intraoral, treatment of, by radium, 201, 210
Metastatic in bone, 530
Metastatic in vertebrae from the prostate, 534
Of body of uterus, treatment of (abs), 393
Of the breast, present status of radiation therapy of (abs), 478
Of the breast, recurrent, with roentgen-ray fibrosis (abs), 393
Of the breast, roentgen treatment of (abs), 479
Of the breast, spinal metastasis from (abs), 482
Of the cervix, broad ligament extension in, 336
Of the cervix, radiation treatment of (abs), 583
Of the esophagus, radium treatment of (abs), 589
Of the lower jaw, difficult problems in treatment of (abs), 387
Of the stomach, auxiliary methods of diagnosis—radiological and chemical (abs), 461
Primary, of the trachea (abs), 372
Uterine, 365
Uterine, statistical report of roentgen treatment of 800 cases (abs), 270
Carman, Russell D. Portrait opposite 351
Castration and climacteric symptoms (abs), 480
And climacterium, circulatory changes in, especially in myoma (abs), 494
Temporary roentgen, indication for (abs), 395
Catalase of the liver, influence of radium on (abs), 490
Cataracts, immature and incipient, radium treatment of (abs), 481
Cathode rays, high voltage, outside generating tube (abs), 289
Cells, living, study of action of roentgen rays upon (abs), 492
Plant, action of radium on (abs), 496
Cellulitis and local inflammations, roentgen ray in treatment of (abs), 387
Cerebral pneumography, dangers and uses (abs), 268
Cervix, carcinoma of, broad ligament extension in, 336
Carcinoma of, radiation treatment (abs), 580
Chest, bibliography of normal (abs), 288
Normal (abs), 484
Of infant, radiography of, with reference to the "progression of the chest and the determination of the normal" (abs), 382
Chiropractic dislocations of atlas (abs), 369
Cholecystography (abs), 85; 184; 472; 577; 578
Appearance and disappearance of the shadow (abs), 86
Experiences with (abs), 372
In diagnosis of cholecystic disease (abs), 84
Oral administration of tetraiodophenolphthalein for (abs); 377, (E), 545
Recent advances in (abs), 381
Value of (abs), 574
With tetrabromphenolphthalein (abs), 469; 576
Cholelithiasis, clinical features of (abs), 82
Cholesterin, action of roentgen rays upon (abs), 492
Chondrodysplasia, hereditary deforming (abs), 370
Climacteric symptoms after castration (abs), 480
Climacterium and castration, circulatory changes in, especially in myoma (abs), 494
Colon, and colonic ptosis, roentgenoscopy of (abs), 458
Dilatation of, with subacute intestinal obstruction, 326
Constant continuous tension in production of roentgen rays (abs), 492
Constant current, studies on use of, in therapy (abs), 91
Cosmic origin of rays (E), 161
Coxa plana (abs), 564
Vara (abs), 564
Vara, pathogenesis and therapy of (abs), 275
Vara, traumatic, 242
Curiegraphy of experimental tumors by intravenous injection of serum charged with radium emanation (abs), 488
Cysticercosis, pulmonary, roentgen diagnosis of (abs), 186
Cystography with opaque liquids (abs), 467
Czecho-Slovakian Republic, Fourth Scientific Meeting of Association of German Roentgenologists of, 250

Dactylomegaly (abs), 480
Deafness, obstructive, radiation therapy in (abs), 580
Decay constant of radium emanation (abs), 485
Dentistry, preventive (abs), 380
Dermatitis due to freezing, roentgen therapy of (abs), 473
Dermatoses, roentgen-ray treatment of various (abs), 474
Development of roentgen-ray films, laws of (abs), 287
Diaphragmatic hernia (abs), 184
Hernia, congenital, 135
Hernia of the stomach, roentgen appearance of peristalsis in (abs), 573
Diathermy for treatment of malignant growths in combination with roentgen ray (abs), 86
Diverticula, intestinal, 469
Doramad salve used with radium in treatment of roentgen burn (abs), 580
Dosage, convenient and accurate method of measuring, 169
Divided roentgen-ray, study of skin reactions after, 513
Some physical factors in (abs), 278
Stimulative, 476
Study relative to the therapeutic dose of unfiltered radon, 1
Tables as aid to simplification of roentgen-ray technique, 360
Duodenal bulb, roentgen examination of, by the method of the thin layer (abs), 457
Diagnosis, technique of (abs), 81
Stenosis, complicating gastric affections (abs), 460
Ulcer, clinical and roentgen considerations of (abs), 371
Ulcer, roentgen diagnosis of (abs), 375
Duodenum, differentiation of normal and pathological processes (abs), 188

Ear, nose and throat diseases, roentgen-ray therapy in the non-surgical treatment of (abs), 479
Echinococcus of the liver, roentgen diagnosis of (abs), 81
Eczema, acute, treatment with roentgen rays (abs), 481
Infantile, radiation of thymus in (abs), 457
Egg of hen, a comparison between effects of roentgen ray and aging on (abs), 288
Electrocoagulation and radiation therapy in malignant disease of the ear, nose and throat (abs), 391
Emanation tubes, radium, device for sealing off (abs), 286
Endocrine changes following uterus extirpation, surgical castration, roentgen castration and normal climacterium (abs), 292
Glands, irradiation of, in cancerous individuals (abs), 87; 578
Glands, a new method for the stimulation of, with radium, 520

Epicondylitis, 84
Epiphyses of femur, arterial vessels of, and their relations to normal and pathological processes (abs), 566
Epiphysitis (E), 446
Epithelioma of penis treated by radium and roentgen rays, 36
Erythrocytes, velocity of sedimentation of, in roentgen-ray therapy cases (abs), 286
Esophagus, obstruction of (abs), 379
  Radium treatment of carcinoma of (abs), 589
Exostosis bursata, problem of (abs), 571
Exposure, snap shot versus time (abs), 191
Eye of rabbit, normal and infected, experimental studies on effect of roentgen rays upon (abs), 491

Female genital organs, roentgen treatment of (abs), 589
  Genital organs, treatment of inoperable cancer of (abs), 580(2); 582
Fertility and sex ratio, effect on, of substerility exposures to roentgen rays (abs), 271
Fibromyoma, operations on cases unsuccessfully treated by roentgen rays (abs), 478
  Of the uterus, treatment of (abs), 475
Film reductions, positive, from roentgen-ray plates (abs), 484
Films, rigid, in roentgenography of the mouth (abs), 283
Fistulas, chronic ulcerating, treatment of with thorium X (abs), 191
Fluoroscopy, biplane, in treatment of fractures (abs), 271
Focal infections, radiation therapy in (abs), 580
Foot, sesamoid anomalies of (abs), 572
Foreign body in lung, atelectasis caused by (abs), 573
Fractional roentgen irradiation, 115
Fracture stretcher, new radiolucent (abs), 271
Fractures, biplane fluoroscopy in treatment of (abs), 271
  Of carpal navicular bone (abs), 381
  Of radius, typical (abs), 380
  Their roentgenological interpretation (abs), 380
  Traumatic, of vertebral column (abs), 466
Fungi, pathogenic, effect of radium and roentgen rays on (abs), 491

Gall-bladder (see also cholecystography)
  Clinical significance of visualization by tetraiodophenolphthalein (abs), 379
  Disease, secondary evidence of, 58
  Its visibility after injections of tetrabromphenolphthalein (abs), 576
  Roentgen examination of (abs), 456
  Roentgen rays as aid in diagnosis of pathological (abs), 462
  Roentgenologic demonstration of (abs), 185
  Roentgenologic demonstration of the pathological (abs), 457
  Roentgenologic visibility of, after administration of alkaline bromides (abs), 468
  Visualized, effect on, of duodenobiliary drainage (abs), 273
Gallstones, chemical composition of, in Dutch India (abs), 577
Gastric affections, non-neoplastic, roentgen treatment of (abs), 473
  And duodenal roentgen-ray finding after operation (abs), 370
  Peristalsis and spasm, various forms of, in the roentgen picture (abs), 81
  Tumors, benign and malignant in same patient, roentgen diagnosis of, 542
Gastritis, chronic, roentgen-ray signs of, 323
Gastroduodenal anatomy and physiology, radiologic considerations of (abs), 290
Gastrointestinal conditions roentgenologically considered (abs), 464
Generator, new, for medical roentgenology (abs), 293
Goetsch's test in the roentgenotherapy of Basedow's disease (abs), 486
Graham's method of cholecystography (abs), 85
Graphical methods of calculation in radium therapy, 451
Grounding, insulation versus, as protection against shocks, 49
Gynecologic conditions, benign, radioactive pessaries in treatment of (abs), 86
Gynecological practice, high voltage roentgen-ray therapy in (abs), 477
Gynecology, devices for use of radium in (abs), 292
  Indications for radiation therapy in (abs), 477
  Position of deep roentgen therapy in (abs), 89
  Progress of radiation therapy in (abs), 386
  Review of four years' work with radium in (abs), 384

Head, vertical and horizontal planes of (abs), 91
Heart, function and radioactivity (abs), 495
  Growth of, roentgenographic observations (abs), 486
  Investigation of movements of, by use of slit diaphragm and moving film (abs), 488
  Size, value of long focus roentgenography in comparative investigations of (abs), 471
Heliotherapy, physical and biological problems in, 193
Helium, radium and mesotherium, commercial production of (abs), 490
Hemorrhage, benign, roentgen treatment of (abs), 270
  Uterine, control of, by roentgen ray (abs), 390
Hereditary abnormalities of the viscera; special reference to abnormalities of kidneys (abs), 484
Hernia, diaphragmatic, 135; (abs), 184
Hip, chronic arthritis of, with subluxation and ankylosis in adult (abs), 460
  Congenital dislocation of, 258
  Non-tuberculous of early life (abs), 564
Hodgkin's disease of the sternum, 525
Hypophysial adenomata (abs), 291
  Pressure symptoms due to hydrocephalus (abs), 187

Illinois State Medical Society, section on radiology, 549
Induction coil, effect of capacity on (abs), 283
Infections, focal, radiation therapy in (abs), 580
  And suppurations, coccus, roentgen treatment of, 332
Inflammations, local, cellulitis and carbuncles, roentgen rays in treatment of (abs), 387
  Roentgen treatment of (abs), 481
Injuries, late roentgen, of skin, clinical features and pathogenesis of (abs), 482
Instruction of physicians in roentgenology (abs), 278
Insulation versus grounding as protection against shock, 49
Intestinal obstruction, subacute, with unusual dilatation of colon, 326
Intestine, small, physiological movements of (abs), 272
Intraoral carcinoma, treatment of, by radium, 201, 210
Iodipin, (see also lipiodol)
  As a pyelographic medium (abs), 267
  For diagnosis of spinal subarachnoidal block (abs), 263
  In diagnosis of bronchiectasis (abs), 265
  In roentgen diagnosis in respiratory organs (abs), 265
Iodized oil (lipiodol) in roentgenology (E), 352
Ionization chamber, theoretical and experimental study (abs), 90
  Of air, determination of energy used by roentgen rays of different wave lengths (abs), 279

Irradiation (see also radiation)
Fractional roentgen, 115
Mild (abs), 87; 590

Jaw, lower, carcinoma of, difficult problems in treatment of (abs), 387
Joint, persistent contracture of (arthrogryposis) (abs), 266
Joints, experimental studies on roentgen anatomy and pathology of (abs), 277
Tuberculosis of, early diagnosis and treatment of (abs), 464
Tuberculous, roentgen-ray appearance of (abs), 468

Keratitis in a guinea pig eye following extra soft irradiation (abs), 485
Kidney pelvis and ureter, dilatation of, during pregnancy (abs), 377
Kidney shadow under pneumoperitoneum (abs), 470
Kidneys, a morphological study with special reference to abnormalities of, in descendants of *x*-rayed mice (abs), 484
Knee, diagnosis of diseases and injuries of (abs), 469
Köhler's disease of the os naviculare and metatarsus (abs), 83
Disease of the tarsal scaphoid (abs), 563

Laryngeal catheter as an aid in bronchography (abs), 573
Legg's disease (see osteochondritis deformans juvenilis coxae)
Leucemia, from radioactive bodies (abs), 292
Lymphatic, neoplastic nature of, and its relation to lymphosarcoma, 497
Lilienfeld tube, use of, in roentgenography (abs), 288
Lip, lower, cancer of (abs), 389
Lipiodol, and iodipin in diagnosis of spinal lesions, 431
And other iodine contrast material in demonstration of bronchi (abs), 187
As aid in demonstration of pulmonary pathology in tuberculosis (abs), 368
As aid in diagnosis of bronchopulmonary lesions including tuberculosis (abs), 368
Demonstration of bronchial tree by means of, 65
For roentgen studies of normal and diseased bronchi (abs), 265
For roentgenograms of tear ducts (abs), 471
In the bronchial tree (abs), 82
In diagnosis of bronchiectasis (abs), 83; 189
In diagnosis of subdural tumor of lumbosacral cord (abs), 471
In diagnosis of tumor of spinal cord (abs), 267
In diagnosis of vertebral canal (abs), 268
In roentgenology (E), 352
Injection of, in bronchial dilatation with sinistrocardia (abs), 459
Liver abscess and pylephlebitis following appendicitis (abs), 180
Liver, catalase of, influence of radium on (abs), 490
Post mortem autolysis of, effect of roentgen ray upon (abs), 92
Lung abscess, bronchoscopic treatment of, 419
Abscess, medical standpoint, 407
Abscess, roentgen-ray diagnosis of, 410
Abscess, study of 22 cases (abs), 472
Abscess, surgical aspects of, 421
Apex, improved technique for demonstration of in roentgenogram (abs), 373
Apex roentgenography, technique of (abs), 264; 267
Atelectasis in (abs), 573
Importance of apical roentgenogram in tuberculosis of the (abs), 457
Massive collapse of, 456
Lung abscess, roentgenogram and demonstration of the apices (abs), 276
Lymph nodes of neck, involvement of, in oral carcinoma, 205
Lymphoblastoma (Hodgkin's disease) of the sternum, 525
Lymphosarcoma, relation of lymphatic leucemia to, 497
Two cases of (abs), 472

Malacia of the sesamoid bone of the first metatarsal, a typical disease picture (abs), 377
Malignancies, alimentary tract, radiation treatment of, 441
Breast, radiation treatment of, 442
Cervical, radiation treatment of, 440
Deep-seated, radiation therapy in (abs), 89
Genito-urinary tract, radiation treatment of, 443
Metastatic, radiation treatment of, 444
Radiation treatment of, 436; (abs), 397
Treatment of, by diathermy and deep roentgen therapy (abs), 86
Uterine, radiation treatment of, 443
Massive collapse of the lungs (abs), 456
Mastoiditis (abs), 371
Measurement, methods of, in practical radiotherapy (abs), 494
Of roentgen-ray dosage, unification of (abs), 495
Measurements, physical, of radiation and their application to therapy, 551
Mediastinal and lung tuberculosis (abs), 458
Mediastinal tumors, roentgen-ray exposure as aid in diagnosis (abs), 373
Mega-esophagus, roentgen examination in study of (abs), 575
Mesothorium, radium and helium, commercial production of (abs), 490
Metabolic differences, following *x*-radiation, between normal rats and rats immune to Jensen's rat sarcoma (abs), 290
Disturbances following deep roentgen therapy (abs), 284
Metatarsal, first, malacia of sesamoid bone of (abs), 377
Mounting card for film reductions, 78
Muds, various, radioactive effects of (abs), 288
Myeloma, multiple, a case of, resembling transverse myelitis (abs), 460
Multiple, and sporotrichosis, similarity of roentgen findings in, 224
Multiple, in a child (abs), 477
Myoma, circulatory changes in climacterium and castration in (abs), 494
Myomas and metrorrhagias, treatment of, 251
Myositis ossificans progressiva, 328

Nasal accessory sinuses, roentgen diagnosis of (abs), 183
Necrosis, radium (mesothorium) (abs), 284
Needle, new, for implantation of radium emanation in glass tubes (abs), 283
Neoplasms, renal (abs), 185
Transplantable, effect of controlled conditions of illumination upon (abs), 285
Nevo-carcinomas, treatment of (abs), 481
New York, Central, Roentgen Ray Society, 549
New York Roentgen Society, report of one-hundredth meeting of, 449
Nucleus and cytoplasm, comparative action of roentgen ray and radium on (abs), 483

Obstetrics, roentgen diagnosis in (abs), 589
Olecranon, significance of transverse groove in (abs), 184

Ophthalmology, general roentgenological progress and its application to diagnosis and therapy in (abs), 294
Oral administration of tetraiodophenolphthalein for cholecystography (abs), 373; 377; (E), 545
Os hamatum, fractures of (abs), 182
Osteitis deformans (Paget's disease) and its relation to osteitis fibrosa and osteomalacia (abs), 463
Fibrosa and the hyperostotic form of bone syphilis (abs), 190
Fibrosa cystica (abs), 187
Fibrosa cystica, generalized type of (abs), 372
Fibrosa, relation of osteitis deformans to (abs), 463
Osteochondritis, an endocrine disturbance (abs), 565
Deformans juvenilis coxae and related diseases (abs), 83
Deformans juvenilis coxae (Legg-Calvé-Perthes' disease) collection of abstracts, 557–571
Dissecans of the elbow (abs), 468
Syphilitic (E), 546
Osteofibrosa, vacuolated (osteopathy of von Recklinghausen) (abs), 456
Osteomalacia, in China (abs), 465
Relation of osteitis deformans to (abs), 463
Osteomyelitis (abs), 579
Osteomyelitis, chronic, especially of spine (abs), 378
Of the cranial bones secondary to paranasal sinus operations (abs), 464
Osteosarcoma, multiple, of the skull and face, before and after roentgenotherapy (abs), 476
Otitis, chronic, roentgen findings in (abs), 266
Otolaryngology, electrotherapeutic measures in (abs), 473
Ovaries, stimulative roentgen irradiation of (abs), 395
Oxycephaly (abs), 459
With ocular complications (abs), 464

Pancreatitis, chronic, roentgen diagnosis of, and its relation to some of the common skin diseases (abs), 467
Paralyses, peripheral, roentgen treatment of (abs), 581
Patella, developmental anomaly of (abs), 81
Divided (abs), 574
Primary tumors of (abs), 85
Pedunculated growths and gastric mucosa prolapsing through pylorus, diagnosis of, 295
Pelvic inflammations, treatment of, with small doses of roentgen rays (abs), 474
Pelvimetry of superior strait by means of the roentgen ray (abs), 189
Pelvis, sarcoma of (abs), 575
Penis, epithelioma of, treated by radium and roentgen rays, 36
Periduodenitis essentially stenosis (abs), 577
Perigastritis, three cases of (abs), 577
Peristalsis, reverse in bowel, a precursor of vomiting (abs), 282
Roentgen appearance of, in diaphragmatic hernia of stomach (abs), 573
Perthes' disease (see osteochondritis deformans juvenilis coxae)
Pertussis, treatment of, with roentgen rays (abs), 191; 478
Pessaries, radioactive ceramic, for treatment of benign gynecologic conditions (abs), 86
Pfender, Charles Alexander, 167
Phlebitis, aseptic, following injection of tetrabromphenolphthalein (abs), 274
Physikalische und Technische Grundlagen der Röntgentherapie (B.R.), 80
Physiotherapy: Theory and Clinical Application (B.R.), 79
Pituitary tumor, roentgen-ray therapy in (abs), 87
Pleura pulmonalis, human, a study of; its relation to the blebs and bullae of emphysema, 399
Pleuritis, mediastino-lobar, in gland tuberculosis (abs) 263
Pneumoencephalomyelography, value and safety of a simplified method of, 231
Pneumography, cerebral (abs), 268
Pneumonias, postoperative, roentgen therapy of, 251
Pneumoperitoneum, new technique for performing (abs), 279
Pneumoperitoneum to show kidney shadow (abs), 470
Pneumothorax, spontaneous (abs), 187
Poliomyelitis, bone changes in (abs), 184
Polycystic kidney, pyelography in (abs), 467
Polycythaemia rubra, a case of, relieved by roentgen treatment (abs), 396
Portable *x*-ray apparatus (abs), 494
Potter-Bucky diaphragm (abs), 487
Pregnancy, diagnostic and therapeutic *x*-radiation in (abs), 290
Dilatation of ureter and kidney pelvis during (abs), 377
Extrauterine, with secondary abdominal pregnancy (abs), 279
Pyelitis in, 144
Prostatic carcinoma, diffuse vertebral metastasis of, 534
Protection, methods of (abs), 272
Of technical assistants and those handling large quantities of radium or radon, 345
Proteins, effect of roentgen rays upon (abs), 496
Protoplasm, change in, due to irradiation (abs), 495
Psoas abscess, roentgen sign of (Vienna letter), 358
Psoriasis, thymus-thyroid irradiation in (abs), 585
Pubis, roentgenography of, and diagnosis of syphilis (abs), 579
Pulmonary roentgenography, value of soft-ray technique in (abs), 265
Pyelitis in pregnancy, 114
Pyelographic medium, iodized oil as (abs), 267
Pyelography in polycystic kidney (abs), 467
Pylephlebitis and liver abscess following appendicitis (abs), 180
Pylorus, diagnosis of pedunculated growths and mucosa prolapsing through, 295

Quality of roentgen rays, standards of (abs), 493

Radiation, constitutional effects of, 111
Physiological actions of, 96
Primary effects of, on cells, 93
Reparative processes, 98
Theories regarding action of, 95
Therapeutic methods and dosage, 105
Therapy in conjunction with surgery (abs), 579
Therapy of cervix carcinoma (abs), 583
Therapy of collum carcinoma (abs), 584
Therapy of focal infections and obstructive deafness (abs), 580
Therapy of gynecological carcinoma (abs), 587
Therapy of thyroid and thymus in psoriasis (abs), 585
Therapy of tuberculosis of upper respiratory tract (abs), 582
Tissue reactions to, 93
Radiology (in arduis fidelis) (abs), 266
Radium clamp for use in mouth, throat and larynx (abs), 487
Emanation, decay constant of (abs), 485
Mesothorium and helium, commercial production of (abs), 490
Needles, an instrument for introducing, 174
Needles, new devices for implantation and removal of, 76
The alleviator (abs), 388
Therapy (abs), 586; 588
Therapy, graphical methods of calculation in, 451

Radium therapy in skin diseases (abs), 583
Therapy of esophageal carcinoma (abs), 589
Therapy of uterine hemorrhage (abs), 584
Therapy, some factors in (abs), 476
Therapy, status of (E), 247
With doramad salve in treatment of roentgen burn (abs), 578
Radius, fractures of lower end of (abs), 85
Typical fractures of (abs), 380
Radon, unfiltered, dosage study, 1
Rana, egg of, influence of the rapidity of development of, on duration of its survival (abs), 288
Rays, hard, roentgenograms made with (abs), 277
Rays of cosmic origin (E), 161
Rectum, cancer of, radiation treatment of (abs), 388
Renal fluoroscopy, an improved application of the use of, at the operating table (abs), 375
Neoplasms, clinical and surgical aspects of (abs), 185
Roentgenography during operation (abs), 188
Tumors, roentgen-ray diagnosis of (abs), 465
Research, radiotherapeutic, observations on present status of (abs), 479
Respiratory organs, iodipin in diagnosis in (abs), 265
Tract, upper, radiation therapy of tuberculosis of (abs), 582
Rhinophyma (abs), 86
Rickets, roentgen-ray study of 926 cases of (abs), 374
Roentgen burn of hands, treatment of, with radium and doramad salve (abs), 580
Diagnosis in gynecology and obstetrics (abs), 589
Injuries, discussion of, 251
Injuries, late, of skin (abs), 482
Rays, general action of, 285
Rays, indiscriminate use of (abs), 284
Rays in internal medicine (abs), 88
Rays, soft, histological findings in skin of mice and guinea pigs irradiated with (abs), 485
Rays, study of chemical substances and organisms with (abs), 278
Rays, therapeutic value of (abs), 587
Treatment of Basedow's disease (abs), 587
Treatment of bronchial asthma (abs), 586
Treatment of female genital organs (abs), 589
Treatment of peripheral paralyses (abs), 584
Treatment of pulmonary tuberculosis (abs), 588
Treatment of the spleen in asthma (abs), 581
Treatment of sweat gland abscesses of axilla (abs), 588
Treatment of tumors of brain (abs), 581
Roentgenograms made with hard rays (abs), 277
Roentgenography of organs by means of radioactive substances introduced internally (abs), 294
Roentgenologic instruction, 91
Roentgenology, training for practice of (E), 72

Sacroiliac joint, tuberculosis of, 150
Safety device against high tension shocks (abs), 277
Sandborn, Manly J., 168
Sarcoma, a case of, treated with deep roentgenotherapy (abs), 394
Bone, diagnosis and prognosis of (abs), 376
Of pelvis (abs), 575
Round-cell, radium and roentgen rays in the treatment of (abs), 392
Scaphoid bone, accessory (abs), 264
Bone of carpus, fractures of (abs), 381
Scattered roentgen radiation, total intensity of (abs), 486
Schlatter's disease and other allied conditions (abs), 562
Disease of tibial tubercle (abs), 83
Screens, intensifying, influence of temperature upon luminosity of (abs), 275
Sella, roentgenology of, 183
Semilunar carpal bone, displacement of (abs), 368
Seriograph or selector (abs), 271
Sesamoid anomalies of the foot (abs), 572
Sex determination, Sellheim's, and the relation to roentgenologic experience (abs), 90
Sexuality, influence of roentgen ray on, and on formation of mutants in lower fungi (abs), 483
Sickness, roentgen, attempt at prophylactic treatment of (abs), 289
Situs inversus totalis and behavior in electrocardiogram (abs), 464
Skin diseases, radium treatment in (abs), 586
Reactions, study of, after divided roentgen-ray dosage, 513
Skull, air bubbles in interior of (abs), 471
Spectrography, roentgen (abs), 287
Spinal canal, lipiodol diagnosis in (abs), 268
Cord tumor, subdural, diagnosed by lipiodol injection (abs), 471
Lesions, lipiodol and iodipin in diagnosis of, 431
Metastasis from breast carcinoma (abs), 482
Subarachnoidal block, diagnosis of (abs), 263
Tumors, diagnosis of, and roentgen treatment of (abs), 268
Spine, chronic osteomyelitis of (abs), 378
Malformation of the lower (abs), 378
Spleen, irradiation of, effect on blood coagulability (abs), 192
Roentgen therapy of, in asthma (abs), 581
Roentgenologic image of (abs), 457
Spondylolisthesis (abs), 382
Sporotrichosis and multiple myeloma, similarity of roentgen findings in, 224
Standard, minimum, for roentgen-ray service in a hospital (abs), 283
Standards of quality of roentgen rays (abs), 493
Sternum Hodgkin's disease of, 525
Stimulation, biological studies on problem of radiation (abs), 273
Stimulative irradiation, experimental studies on, 251
Roentgen irradiation of ovaries (abs), 395
Roentgen therapy (abs), 476
Stomach, benign tumors of (abs), 181
Carcinoma of, diagnosis of (abs), 461
Diaphragmatic hernia of (abs), 573
Function of, in Biermer's anemia (abs), 574
In the infant, roentgenological studies of (abs), 461
Niches on greater curvature of (abs), 470
Various forms of peristalsis and spasm of (abs), 81
Subdural tumor of lumbosacral cord, lipiodol in diagnosis of (abs), 471
Surgery and radiology, relationship (abs), 282
And radiotherapy, relative values of (abs), 389
Radiation therapy in conjunction with (abs), 579
Sweet localizing apparatus, modification of (abs), 484
Switch for protecting roentgen tubes (abs), 274
Syphilis, diagnosis of, and roentgenography of pubis (abs), 579
Syphilitic osteochondritis (E), 546
Syringomyelia, roentgen treatment of (abs), 268

Talodynia (abs), 459
Tear ducts, roentgenograms after filling with lipiodol (abs), 471
Testicles, influence of irradiation upon development of bones; histological findings (abs), 489
Malignant tumors of, diagnosis, prognosis and treatment, 44
Tetrabromphenolphthalein, aseptic phlebitis following injection of (abs), 274
Cholecystography after injections of (abs), 576
Tetraiodophenolphthalein, clinical significance of visualization of the gall-bladder by use of (abs), 379
Oral administration of, 166; (E), 545

Therapy, deep, prevention and treatment of untoward reactions (abs), 284
Surface, with extra soft roentgen rays (abs), 485
Thomas Sydenham, Clinician, by David Riesman (B.R.), 454
Thorium X, treatment of chronic ulcerating fistulas with (abs), 191
Thrombo-angiitis obliterans, roentgen therapy of (abs), 88
Thymoma, roentgen-ray diagnosis and treatment of (abs), 375
Thymus, enlargement of, roentgen study of 500 children for, 261
Method for estimating size of, 222
Thymus-thyroid irradiation in psoriasis (abs), 585
Thyroid-thymus irradiation in psoriasis (abs), 585
Thyroiditis, Riedel's (abs), 273
Tissue changes after experimental deep roentgen irradiation (abs), 279
Cultures, effect of radiumized media upon (abs), 274
Reactions to radiation (Caldwell Lecture), 93
Respiration, effect of roentgen rays upon (abs), 276
Tissues, growing *in vitro*, biological effects of radium upon, 155
In vitro cultivation of, with reference to production of cancer by means of radium and *x*-rays (abs), 281
Tongue, and oral cavity, treatment of, by radium emanation, 204
Cancer of, results after treatment by radium and roentgen rays, 207
Tonsils, roentgen-ray treatment of hypertrophied and infected (abs), 397
Tower skull (abs), 459
Trachea, primary carcinoma of (abs), 372
And bronchi, roentgenographic demonstration of, 227
Tube, medium and double focus (abs), 272
Tuberculosis, demonstration of pulmonary changes in by injection of lipiodol (abs), 368
Mediastinal and lung (abs), 458
Of joints, early diagnosis and treatment of (abs), 464
Of sacroiliac joint, 150
Of upper respiratory tract, radiation therapy of (abs), 582
Of the uvea, roentgen irradiation of (abs), 397
Pulmonary, diagnosis of (abs), 463
Pulmonary, importance of the apical roentgenogram (abs), 457
Pulmonary, roentgen diagnosis of (abs), 458
Pulmonary, roentgen treatment of (abs), 588
Pulmonary, technique of roentgen therapy in (abs), 280
Pulmonary, use of *x*-rays in diagnosis of (abs), 464
The hilum in, 424
Tuberculous arthritis, changes in the articular surfaces in (abs), 379
Cervical adenitis, radiotherapy in treatment of (abs), 269
Joints, *x*-ray appearance of (abs), 468
Tumor formation and roentgen-ray action (abs), 493
Tumors, benign, of stomach (abs), 181
Of brain, changes in size and relations of lateral ventricles in (abs), 182
Of brain, roentgen-ray treatment of (abs), 269; 581
Primary of patella (abs), 85

Ulcer, chronic peptic, in children (abs), 186
Duodenal, clinical and roentgen considerations of (abs), 371
Duodenal, roentgen diagnosis of (abs), 375
Gastric and duodenal, roentgen therapy of (abs), 394; 395
Peptic, roentgenologic diagnosis of (abs), 369
Ulcerations, chronic, in dog's stomach, produced by *x*-rays (abs), 276
Ultraviolet lamps, standardization of, 193
Light and roentgen rays, influence of, upon actual blood reaction and stimulation of respiratory center (abs), 279
Light and roentgen rays, influence of, upon the water, salt and protein content of the serum (abs), 280
Radiation (E), 244
Radiation and Actinotherapy, by Eleanor H. Russell and W. Kerr Russell (B.R.), 261
Rays combined with roentgen rays in treatment of acne (abs), 393
Rays in the Treatment and Cure of Disease, by Percy Hall (B.R.), 262
Rays, injurious use on old *x*-ray burns (abs), 280
Rays, standardization of, 549
Unit, *x*-ray, for examination of material in quantity (abs), 488
Ureter and kidney pelvis, dilatation of during pregnancy (abs), 377
Ureteral strictures, kinks and abnormal inserts (abs), 181
Ureters, kinks that are not kinks (abs), 459
And renal pelves, complete bilateral reduplication of, 149
Urethra, male, roentgenology of (abs), 263; 577
Urethrography (Vienna letter), 356
Urinary calculosis, bilateral (abs), 461
Urography (abs), 82
Uterine carcinoma, 365
Fibromyomata, treatment of (abs), 475
Hemorrhage, analysis of 60 cases treated by radium (abs), 383
Hemorrhage, benign, treatment of, with radium (abs), 398
Hemorrhage, radium treatment of (abs), 584
Neoplasms, non-malignant, treatment with radium (abs), 395
Uterus, action of radioactive substances on isolated (abs), 281
Carcinomas of, statistical report of roentgen treatment of 800 cases (abs), 270

Ventricle, third, dilatation of (abs), 187
Ventriculography (abs), 264
Verruca plantaris and callositas, *x*-ray treatment of and remarks on pathogenesis of (abs), 388
Vertebral column, anatomical note on a possible source of error in *x*-ray findings of the normal (abs), 487
Column, traumatic fractures of (abs), 466
Veterinary medicine, present status of roentgenology in (abs), 90
Vicia faba, effect of roentgen rays on seed and young plants of (abs), 293
Vienna letter, 356
Von Recklinghausen's disease (abs), 456

Wave lengths, different, selective action of (abs), 284
Of radiation, studies in effectiveness of (abs), 287
Whooping cough, does roentgen ray modify course of (abs), 384

Yeast cells, effect of roentgen rays upon (abs), 496

AUTHOR INDEX TO VOLUME XV

Abramowa, Alexandra, 571
Abt. I. A., 456
Achard, Th., 456
Adair, Frank, 1
Adams, John D., 81, 368
Aime, P., 459
Altschul, Walter, 224
Alvarez, Walter C., 282
Ancel, P., 288
Anderson, C. C., 456
Andrassy, Karl, 191
Archibald, Edward, 368
Arnell, John C., 1
Arnold, Wilhelm, 81
Arnone, Gioacchino, 572
Attinger, E., 457

Baensch, 81
Bagg, Halsey J., 484
Bailey, Percival, 291
Baker, E. L., 184
Balli, Ruggero, 572
Ballou, David H., 368
Bardachzi, Franz, 288
Bassler, Anthony, 323
Bastings, L., 485
Battaglia, Filipo, 472
Bauer, Friedrich, 481
Bauermeister, W., 81
Baum, Felix, 457
Baumgartner, J., 557
Becchini, G., 573
Beck, Joseph C., 473
Beck, Oscar, 573
Béclère, H., 460
Belden, Webster W., 58
Bellucci, Bruno, 192
Belot, 457
Belot, J., 481
Bensaude, R., 473
Berg, H. H., 82
Bernhard, Frieda, 192
Bianchi, Giovanni, 573
Bianchini, A., 82
Bischoff, L., 457
Black, Hugh S., 383
Black, Louisa T., 457
Black, Paul, 383
Blaine, Edward S., 369
Blencke, Hans, 557
Block, Frank B., 475
Blue, James A., 283
Blumer, L., 288
Boardman, Walter W., 574
Bolliger, Adolph, 284
Bonanno, Matteo, 574
Boquet, 457
Borak, J., 277, 473
Bormann, S., 481
Bott, Oskar, 474
Bouchut, L., 458
Bowen, David R., 169
Boyd, W. A., 558
Braasch, William F., 82
Bradley, Robert A., 169
Breuer, Roland G., 458
Brooks, H. L., 481
Brown, Harold F. R., 207
Brown, Maurice, 474
Bucky, 485
Burill, 577
Burrell, L. S. T., 83
Buschke, A., 485
Businco, Ottavio, 574
Butler, P. F., 144
Büttner, Georg, 558

Caan, Paul, 83
Calabrese, Giulio A., 278
Calot, F., 559
Cameron, W. H., 214
Campbell, Horace E., 370
Carman, Russell D., 84, 369
Carnett, John Breton, 84
Carruthers, F. Walter, 559
Carter, L. J., 482
Carter, Ralph M., 84, 85
Cary, Samuel B., 149
Case, James T., 283, 370
Cathcart, John W., 358
Charles, Andrew, 86
Chizzola, Giuliano, 486, 575
Christie, A. C., 374, 375
Ciaccia, Salvatore, 575
Cipriani, Francesco, 459
Clark, John G., 475
Coe, Fred O., 222
Cohen, Henry, 85
Cole, Lewis Gregory, 459
Cole, Percival P., 482
Cole, W. H., 85, 373
Colin, William, 242
Coolidge, W. D., 289
Copher, G. H., 86, 373
Costello, Jos. P., 475
Cottenot, Paul, 476
Coyon, Am., 459
Crain, R. Carter, 476
Crevoisier, P., 289
Crowther, J. A., 283
Cunha, Juan, 290
Cushway, B. C., 579

Dabney, S. G., 371
D'Amato, Guiseppe, 576
David, S. D., 560
Davis, Frederick A., 459
Davis, Kenneth S., 372
Dean, Archie L., 1
Debet, Pierre, 460
Debicki, Josef J., 90
De Buys, L. R., 486
De Foe, O. K., 486
De Langen, C. D., 577
Denman, Ira O., 580
De Raffele, 560
Diamond, Joseph S., 371
Dodds, Edward C., 290
Dognon, A., 291
Donaldson, Malcolm, 580
Dorland, W. A. N., 290
Dott, Norman M., 291
Doub, Howard P., 284
Dresser, Richard, 525
Duke, William W., 179
Durham, Paul E., 283
Duval, Pierre, 460, 577

Egaña, Albert R., 561
Einhorn, Max, 372, 381
Eisendrath, Daniel N., 181
Eising, Eugene H., 372
Eliason, E. L., 180, 181, 295
Elsberg, Charles A., 182
Emile, Weil P., 292
Emmett, J. Morehead, 383
Engel, Gilson Colby, 577
Esau, 182
Eskuchen, Karl, 263
Evans, Wm. A., 373, 497
Ewing, James, 93

Faber, Harold K., 384
Fabry, Joh., 580
Failla, G., 1
Farmer, Thomas T., 384
Fasiani, G. M., 577
Fenwick, P. C., 292
Fischer, Heinrich, 86
Flaskamp, Wilhelm, 385
Flatau, W. S., 476
Fleischner, Felix, 263
Flesher, Emmert, 204
Forestier, J., 352
Forsdike, Sidney, 580
Fraenkel, Manfred, 90, 578
Fraikin, 577
Frazier, Chester N., 477
Freedman, A. O., 487
Fricke, Hugo, 90
Fricke, Robert E., 477
Frumkin, A. P., 263
Fürst, Walter, 477
Furstenberg, A. C., 227

Gabriel, G., 91
Gallino, M. Miranda, 581
Gassul, R., 264, 373
Gatellier, Jean, 577
Gaube, Konrad, 460
Gaugele, Karl, 562
Geist, Emil S., 264
Gerber, Isaac, 385
Gilmore, M. E., 477
Giordano, D., 461
Giovetti, Vittorino, 578
Glasser, Otto, 90
Glogauer, Otto, 578
Goldhamer, Carl, 91
Goldhamer, K., 277
Goldsmith, Norris W., 1
Gosset, A., 579
Gonell, H. W., 278
Grady, Henry W., 65
Graham, E. A., 54, 373
Grandy, Charles C., 168
Grant, Francis C., 264
Grattan, James Francis, 86
Grier, G. W., 183, 201, 215, 436
Grillon, Ph., 293
Groedel, Franz M., 91
Groover, T. A., 374, 375
Grossmann, G., 80
Grunenberg, K., 185
Guarini, C., 581

Haardt, Wilhelm, 487
Haas, Ludwig, 183, 582
Hager, B. H., 375
Hajós, K., 92
Halberstaedter, L., 87
Hall, Percy, 262
Harris, W. L., 386

Hartley, J. N. J., 562
Hartman, F. W., 284
Haslinger, F., 265
Hasselwander, Albert, 367
Hassin, George B., 184
Heaney, N. Sproat, 377
Heimann, Fritz, 87, 386
Heine, J., 184
Hemler, William Francis, 49
Hempel-Jörgensen, P., 478
Hensen, E. Bennette, 563
Herger, Charles C., 392
Herman, Karl, 184
Hermann, Heinrich, 277
Herzog, R. O., 278
Hess, Julius H., 478
Heuser, Carlos, 579
Heyman, James, 582, 583
Hickey, P. M., 227, 254
Higgins, W. F., 488
Hill, Henry G., 579
Hodges, Fred M., 387
Hoffman, Frederick L., 284
Hofhauser, St., 92
Holbeach, C. H., 487
Holfelder, Hans, 478, 479
Holzknecht, Guido, 278, 332
Hopkins, J. Gardner, 269
Hotz, 461
Hotz, G., 479
Howe, Alexander C., 387
Hubeny, M. J., 290
Huber, O., 184
Hudson, Bernard, 265
Hurst, Arthur F., 461
Hyman, Abraham, 185

Illingsworth, C. F. W., 472
Itchikawa, 488

Jaloustre, L., 490
Jarvis, D. C., 479
Johnson, A. Syme, 462
Johnson, B. A., 274
Johnson, Frederick M., 387
Joly, Marcel, 394
Jones, Thomas E., 388
Jullien, L., 463

Kaplan, Ira I., 87
Karshner, Rolla G., 258
Kaye, G. W. C., 488
Kehl, 563
Kennedy, William H., 584
Kern, Richard A., 407
Key, J. Albert, 564
Keyes, Edward L., 44
Killinger, R. R., 480
Klieneberger, Carl, 88
Knaggs, R. Lawford, 463
Knapp, Victor, 375
Knox, Robert, 488
Kolodny, Anatole, 279, 376
Komuro, Hideo, 293
Kottmaier, Jean, 489
Kotzareff, A., 293, 294
Kramarenki, Jurij, 279
Kramer, Eva, 279
Kraus, Erik J., 463
Kraus, Fritz, 584
Kretschmer, Herman L., 377
Kriegesmann, L., 279
Kroetz, C., 279, 280, 489
Krontowski, A. A., 280
Kuhlman, B., 285
Küstner, Heinz, 292

Lacassagne, A., 294
Lahm, W., 584
Landau, Walter, 265, 280
Lange, F., 464
Lapenna, Marino, 489
Laurin, E., 268
Lawrence, W. S., 244
Lawson, Wilfred, 290
Leddy, Eugene T., 169, 388
Ledoux-Lebard, R., 394
Lemay, P., 490
Lenk, R., 265, 394, 395
Lenz, Maurice, 210, 215
Leonard, Ralph D., 81
Lepennetier, F., 457
Lerner, Macy L., 464
Leucutia, T., 373, 497
LeWald, Leon T., 464
Lewin, Philip, 266, 464
Liberson, Frank, 231
Liescheid, Alfred, 565
Lillie, Harold I., 464
Lipschutz, Emanuel W., 326
Loewy, G., 579
Luscinian, Joseph H., 530
Lüttge, W., 390
Lynham, J. E. A., 464

McArthur, L. L., 280
McCafferty, Lawrence K., 388
McCarthy, C. Lee, 388
McCullough, C. J., 150
McGregor, D. B., 266
McGuffin, W. Herbert, 389
McKenzie, Roger B., 574
McKinney, Joseph T., 149
McNally, William D., 281
McWhorter, G. L., 565
Maczak-Ottenburg, Hugo, 288
Magruder, L. Freeland, 328
Maki, S., 281
Martin, Charles L., 336
Marty, P., 459
Marxer, O. A., 469
Mattick, Walter L., 360, 513
Maubert, A., 490
Maxwell, J. Preston, 465
Mayer, Ernst G., 266, 294
Mayo, William J., 389
Meinicke, Ernst, 267
Melville, Stanley, 83
Menees, Thomas O., 377
Mennet, 395
Menville, Leon J., 273
Merritt, E. A., 374, 375
Mestschanski, J., 585
Meyer, Keith T., 465
Miescher, G., 482
Milani, E., 468
Miles, Lee M., 465
Miller, William Snow, 399
Mixter, Wm. Jason, 267
Möbius, Hans, 586
Moore, R. B., 490
Moore, Sherwood, 373, 466
Moppert, G. G., 557
Morgan, J. D., 115, 215
Mornard, Pierre, 460
Mottram, J. C., 281, 290
Moynihan, Berkeley, 282
Müller, A., 586
Müller, Ernst, 490
Müller, Walther, 377
Muller, George P., 421
Myerson, M. C., 390

Nadson, G. A., 483
Nahan, L., 481
Negro, Mario, 467
Neihardt, Deo, 491
Neuswanger, C. H., 267
Newcomet, William S., 390
Nipper, W. W., 486
Norsworthy, O. L., 174, 395
Nussbaum, A., 566

O'Reilly, Archer, 378
Oehlecker, F., 378
Oleson, Richard B., 274, 469
Ollerenshaw, Robert, 282
Opitz, Erich, 396
Osann, Mathilde, 496
Osmond, John D., 379
Oury, P., 473

Palefski, I. O., 379
Palvarini, Aldo, 586
Pancoast, Henry K., 214, 410
Parkes, A. S., 271
Passow, Arnold, 491
Patterson, S. W., 396
Pauli, W. E., 491
Pearce, Louise, 285
Pendergrass, Eugene P., 295
Penfield, Wilder G., 268
Perkins, C. Winfield, 216
Perona, Pietro, 271
Perthes, Georg, 567, 568
Petrén, K., 268
Pfahler, George E., 89, 213, 365, 391
Phemister, D. B., 379
Philippov, G. S., 483
Philips, Herman B., 88, 271
Piccinino, Guido, 258
Piergrossi, Lamberto, 491
Pilger, W., 89
Pirie, A. Howard, 587
Pirondini, Eugenio, 467
Piston, Donald S., 451
Pohle, Ernst A., 193, 286
Pöhlmann, Carl, 90
Pollock, Harry L., 473
Poole, H. H., 286
Porcher, 460
Pordes, Fritz, 587
Pörsch, A., 380
Portmann, U. V., 391
Prelinger, H., 495
Pribram, B. O., 185
Proctor, Oscar S., 186
Prusciano, F., 587

Quimby, Edith, 1
Quimby, Will A., 467

Rahm, Hans, 287
Ranson, John R., 397
Raper, Howard R., 380
Reich, H., 568
Reich, Leo, 272
Reider, H., 272

Reinberg, Sam A., 186
Reiss, P., 483
Rhein, John H. W., 187
Rigler, Leo G., 542
Riviere, Clive, 484
Roberts, R. E., 85
Roberts, W. E., 484
Robinson, H. C., 377
Rocchi, G., 272, 588
Roffo, A. F., 492
Rogers, Fred T., 336
Ross, W. L., 397
Röver, F., 588
Rump, Walter, 492
Russell, Eleanor H., 261
Russell, W. Kerr, 261
Rütz, A., 588
Ryan, E. J., 372, 381

Sabatini, G., 468
Salmond, R. W. A., 468
Samuel, E. C., 486
Saralegui, J., 492
Scheerer, Richard, 397
Schelenz, Curt, 187
Schempp, Erich, 589
Schereschewsky, J. W., 287
Schirmer, A., 468
Schmidt, Ernst A., 431
Schmidt, James M., 387
Schoenhof, Clara, 493
Scholten, Gustav C. J., 190
Schreiner, Bernard F., 207, 215, 392
Schüller, Artur, 91
Schumacher, Paul, 589
Schwarz, Gottwald, 590
Scott, R. A., 398
Seemann, H., 493
Seide, Jakob, 273, 284
Sellheim, Hugo, 565
Sgalitzer, M., 494, 573
Shaw, A. F. B., 273
Shedlov, Abraham, 569
Sheldon, Albert R., 484
Siciliano, Luigi, 494
Sielmann, Richard, 187
Silbert, Samuel, 182
Silverman, Daniel N., 273
Simons, Albert, 191
Simpson, Frank E., 204, 215
Simpson, Walter M., 534
Singer, J. J., 54
Singer, Walter, 569
Sisk, J. Newton, 187
Sittenfield, M. J., 155, 274
Sklarz, Ernst, 485
Smith, Lawrence W., 191
Smith, Morris K., 269
Smith, R. P., 273
Smithies, Frank, 274, 469
Soiland, Albert, 247
Solomon, I., 473
Sosman, Merrill C., 122, 188
Speed, Kellogg, 381
Speiser, Mortimer D., 135
Spriggs, E. I., 469
Stacy, Leda J., 393
Steenhuis, D. J., 471
Steinberg, Walter, 274
Stenstrom, K. Wilhelm, 274
Stenström, Wilhelm, 360, 513
Stephens, Richmond, 469
Stephenson, R. J., 283
Stettner, E., 275
Stevens, Rollin H., 380
Stewart, Harry Eaton, 79
Stewart, Steele F., 258
Stewart, W. H., 372, 381
Strassmann, Erwin, 494
Strauss, Otto, 185
Struble, Homer P., 384
Stumpf, Pleikart, 275
Sugiura, Kanematsu, 1
Sutherland, Charles G., 470
Sutton, Percy G., 265
Swanberg, Harold, 393

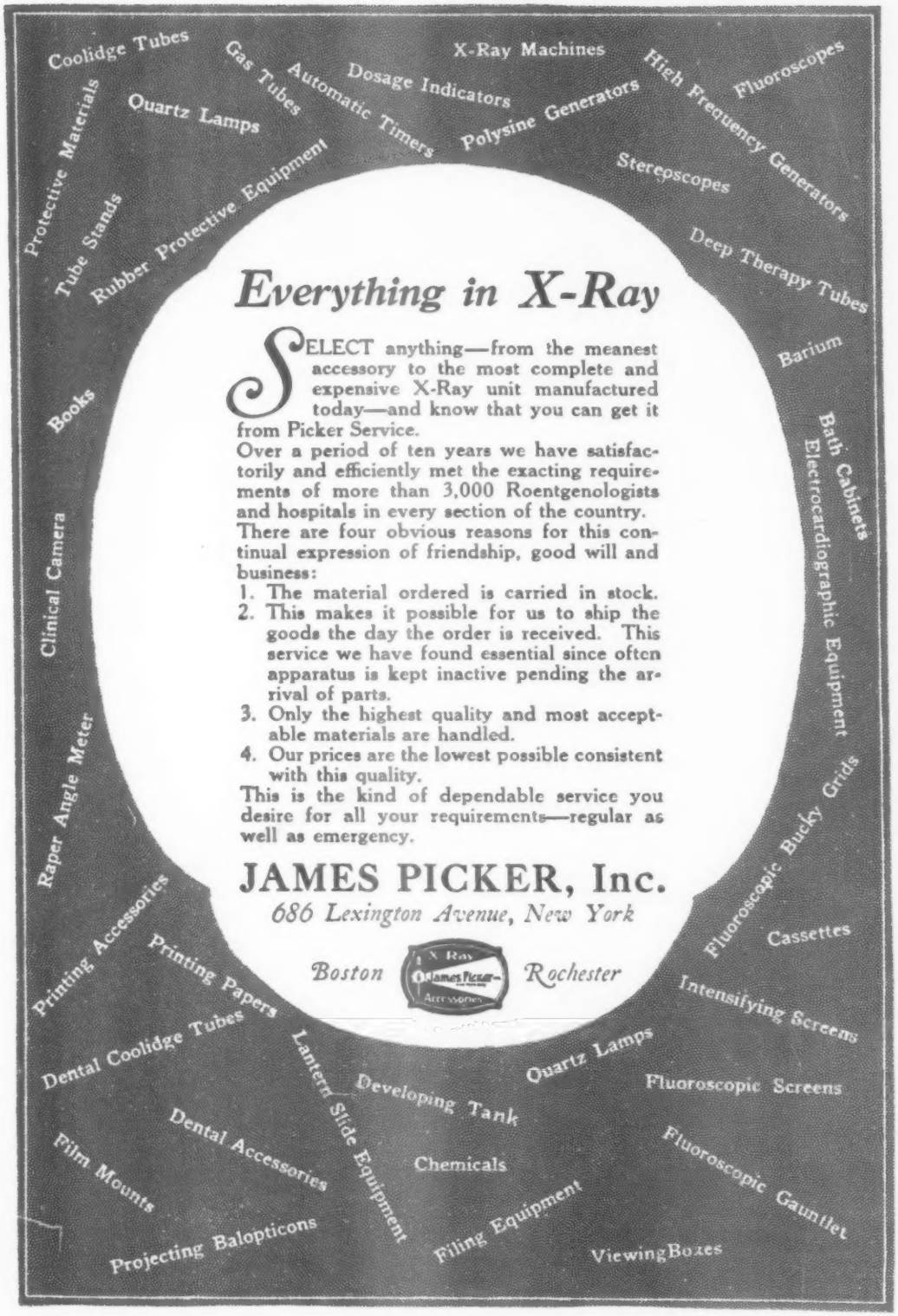
Tchirkin, Nikolas, 382
Tenckhoff, Bernard, 276
Terrada, H. Malter, 581
Teschendorf, Werner, 188, 470
Thiele, Adolf, 496
Thiers, J., 456
Thoms, Herbert, 189
Tillier, R., 570
Towne, E. B., 269
Traub, Eugene F., 393
Tucker, Gabriel, 419
Tunick, Isidor S., 88
Turner, Henry, 382

Unger, Arthur S., 135

Vallarino, J. J., 189
Van Allen, C. M., 285
Van der Hoeve, J., 471
Van Herwerden, M. A., 495
Veraguth, Otto, 471
Viale, G., 495
Vignard, 571
Vintemberger, P., 288
Viol, Charles H., 345
Vogt, E., 270
Vogt, Edward C., 122
Voltz, Friedrich, 190
Von Eicken Carl, 471
v. Kováts, F., 189

Wachtel, Henry, 76
Wadhams, Robert P., 215
Wakefield, Howard, 184
Walter, Arno, 463
Wasson, W. W., 382
Weatherwax, J. L., 169, 388, 551
Weber, E., 495
Weiss, Konrad, 471
Weiss, Kurt, 276
Wels, Paul, 276, 496
Welsch, Gustave, 568
Wilhelm, Seymour F., 190
Wilkie, D. P. D., 472
Williams, E. G. C., 78
Williams, Maud, 496
Wilsey, R. B., 287
Winner, P. S., 472
Wintz, Hermann, 270
Wolf, William, 520
Wolfer, John A., 276
Wolmerhäuser, Otto, 480
Wood, Francis C., 287, 394
Wright, V. W. Murray, 181, 295
Würtz, Paul, 276
Wustrow, P., 275

Zacher, F., 277



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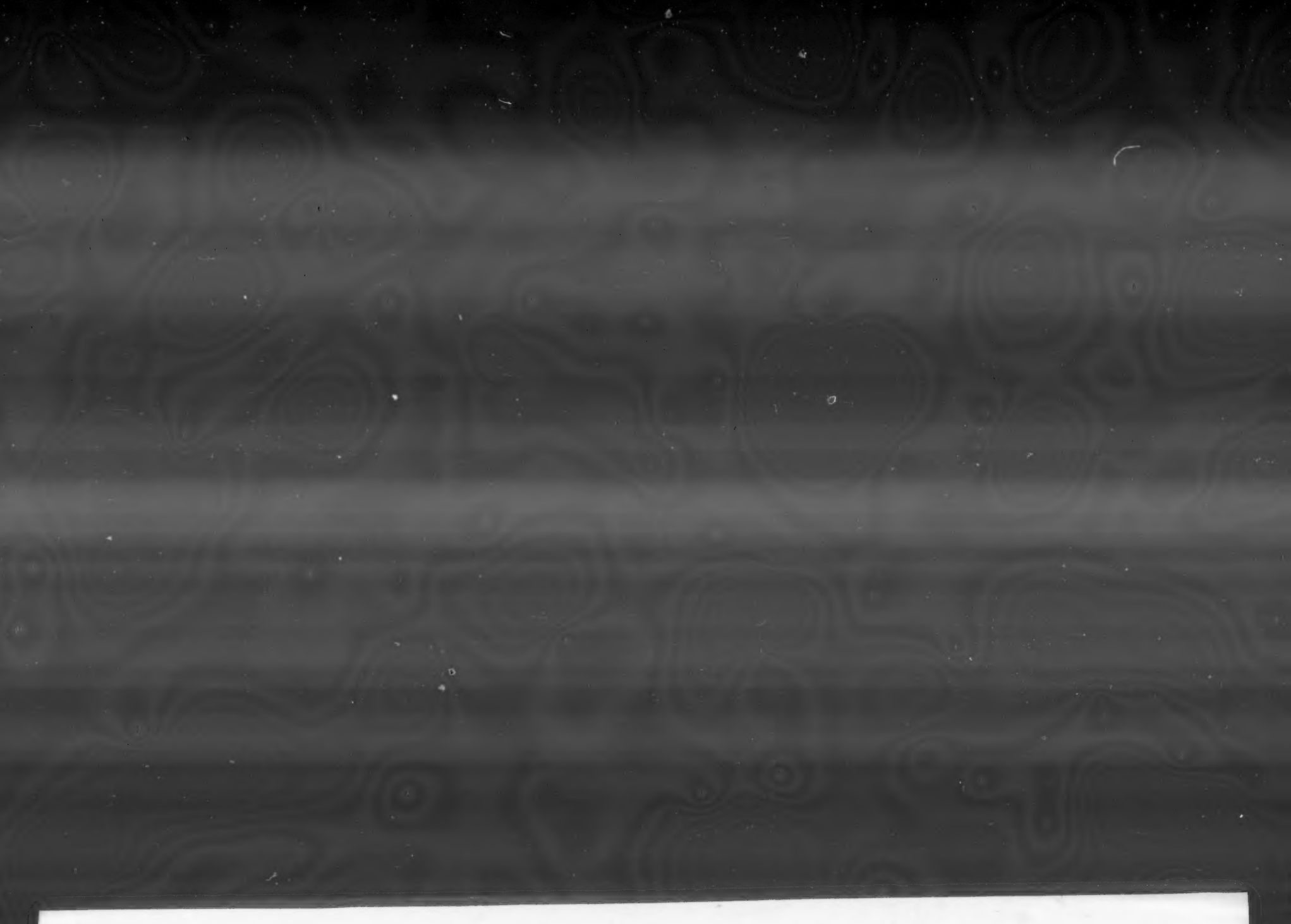
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